# WATER WORKS AND SEWERAGE

September, 1934 — Editor — Vol. LXXXI. No. 9

*A Beauty Spot on Los Angeles Water Supply Area. "Snow-storage" in the High Sierras at 14,000 ft. elevation supplies soft water to the 238 mile aqueduct.*

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# WATER WORKS & SEWERAGE

L. H. ENSLOW,
Editor

## LEADING ARTICLES To Appear in the Next and Subsequent Issues

Herman Forster, Deputy Commissioner of Water, New York City will discuss the "Recreational Usage of Reservoir and the New York Department of Water Supply's system of sanitation control and procedures followed in regulating recreation usage of its reservoirs and land bordering on them.

N. T. Veatch, Jr., Consulting Engineer, Kansas City, Mo., and J. E. White, Superintendent of Water Works and Sewerage, Herington, Kan., will reveal experiences in the reclamation of sewerage effluent for use as industrial water supply at Herington. The article will deal with the economics of the project and the net results to date—emphasizing the marked value of the recovery scheme during the recent drought.

W. L. Eisert, Division Manager, Northeastern Water and Electric Service Corporation, relates and discusses methods found successful in building good will and better public relations for his company.

J. E. Herring, Superintendent of Meters, Jacksonville, (Fla.) will tell of methods employed in the operation of Jacksonville's Meter Department: describe field and shop practices of maintenance, testing and repairing.

L. F. Warrick, Chief Engineer, of the State Board of Health of Wisconsin, will describe successful methods of treatment of milk wastes and canning wastes, developed and adopted in Wisconsin as the most practical available processes of treatment. Results and costs are cited.

John R. Baylis will continue his discussion of "Filtering Materials for Rapid Filters." Methods of testing and a study of the properties of various filtering materials will be next discussed.

C. E. Keefer, Engineer of Sewage Treatment, Baltimore, Md., will discuss sludge dewatering operations at Baltimore. Ordinary sand bed operation v.s. vacuum filtration v.s. the elutriation-filtration process, recently developed at Baltimore, will be compared and cost data presented.

P. S. Wilson, Consultant in Water Works Practice, Glen Ridge, N. J., will continue his series of articles dealing with "Hydraulics" and especially written for the practical water works operator. "Making Fire-Hydrant Discharge Measurements and Their Application to Operating Problems" is the topic to be presented next.

Dr. W. Rudolfs, Chief of Water and Sewage Research, New Jersey Agricultural Experimental Station, Rutgers, N. J., will report further on basic studies of the mechanics of the activated sludge process—including the effect of varying degrees of chlorination. His first article appears in this issue.

I. W. Mendelsohn, Sanitary Engineer, New York City, reports on his observations concerning water supply and sewage treatment in Singapore, Straits Settlements.

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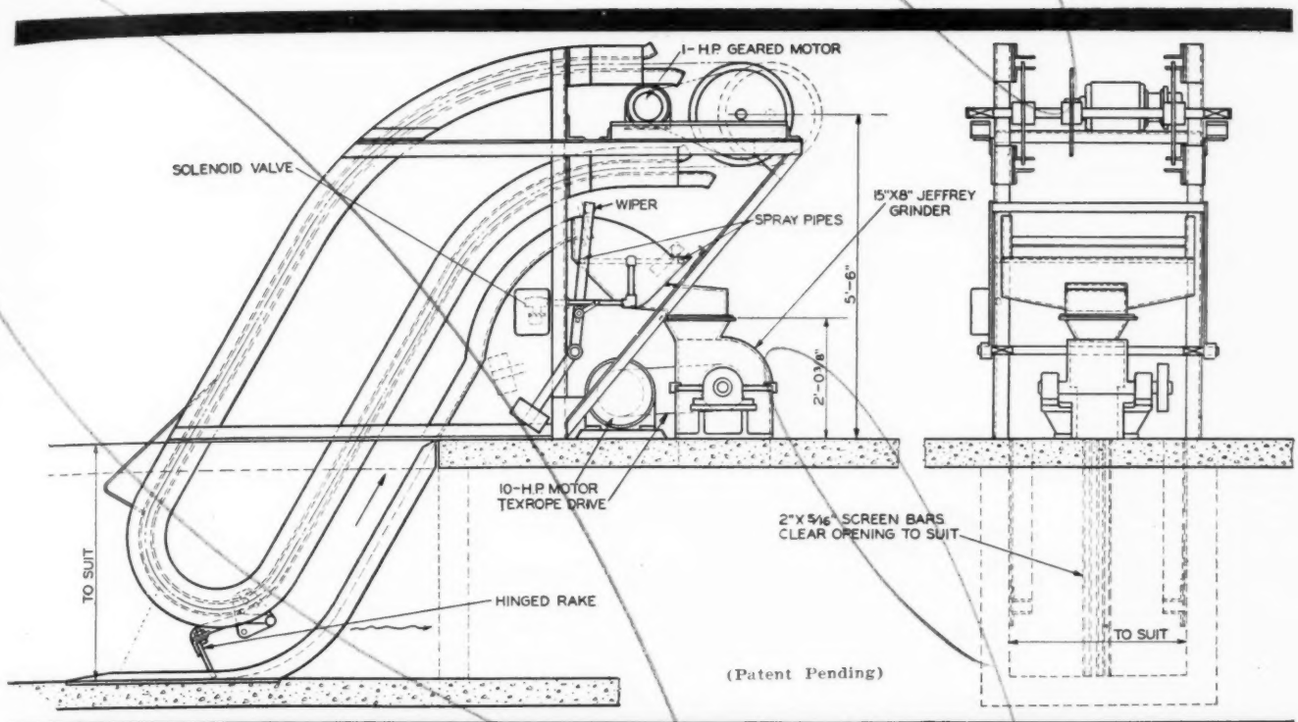


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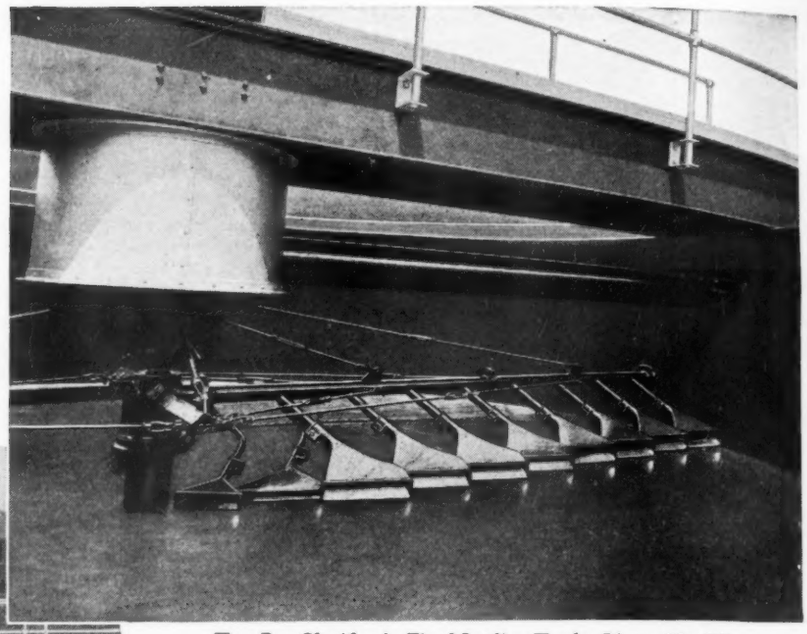

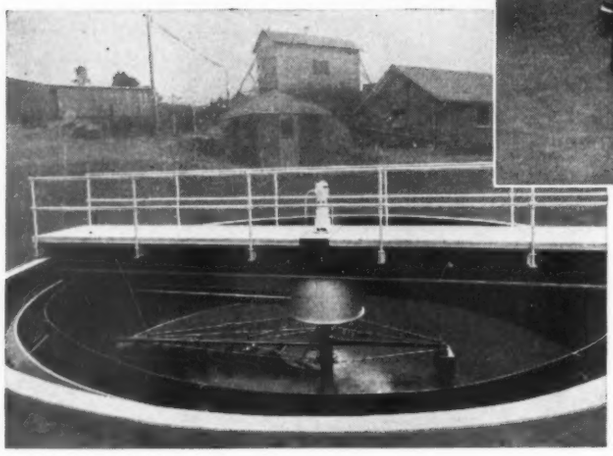

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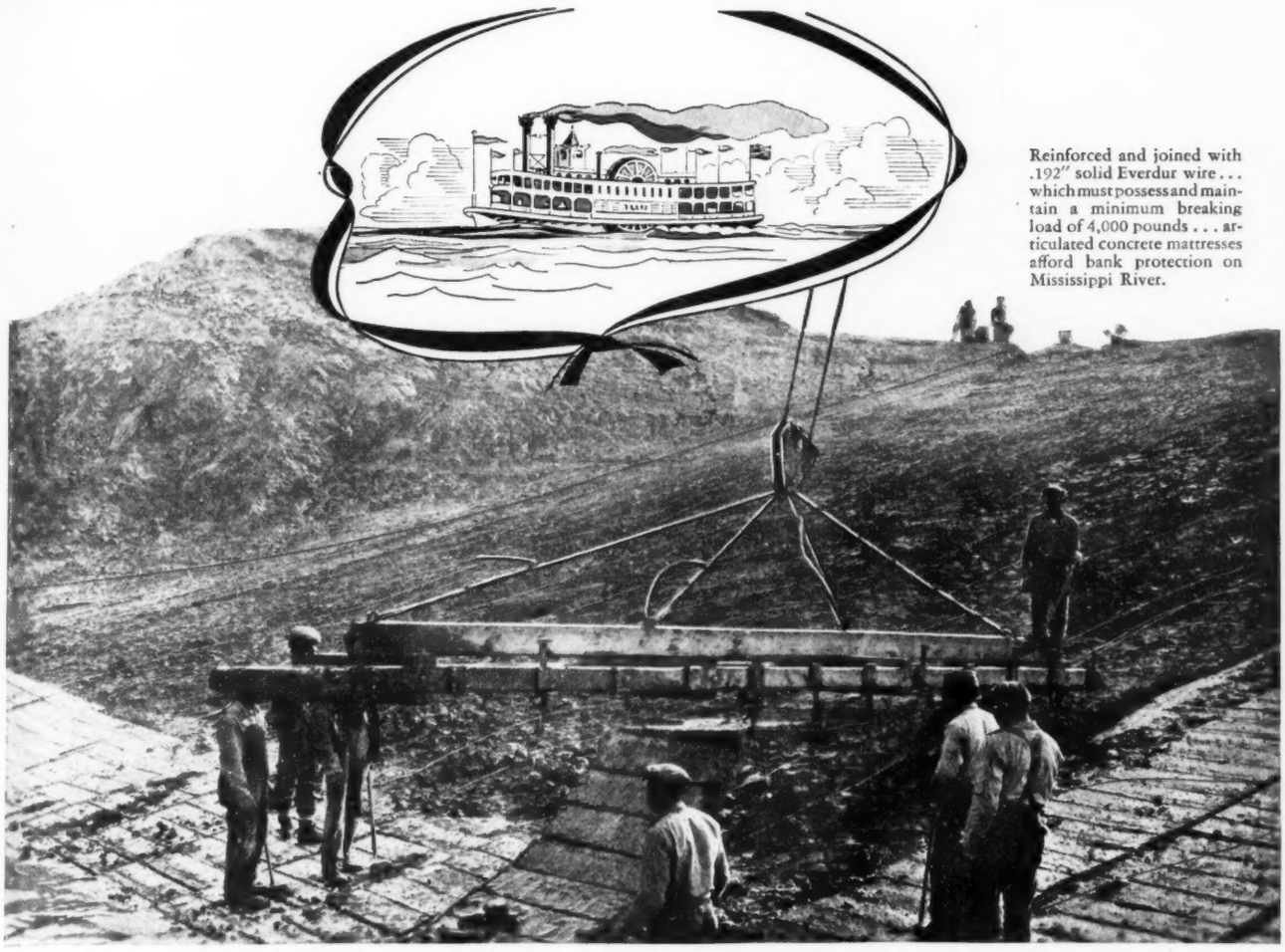

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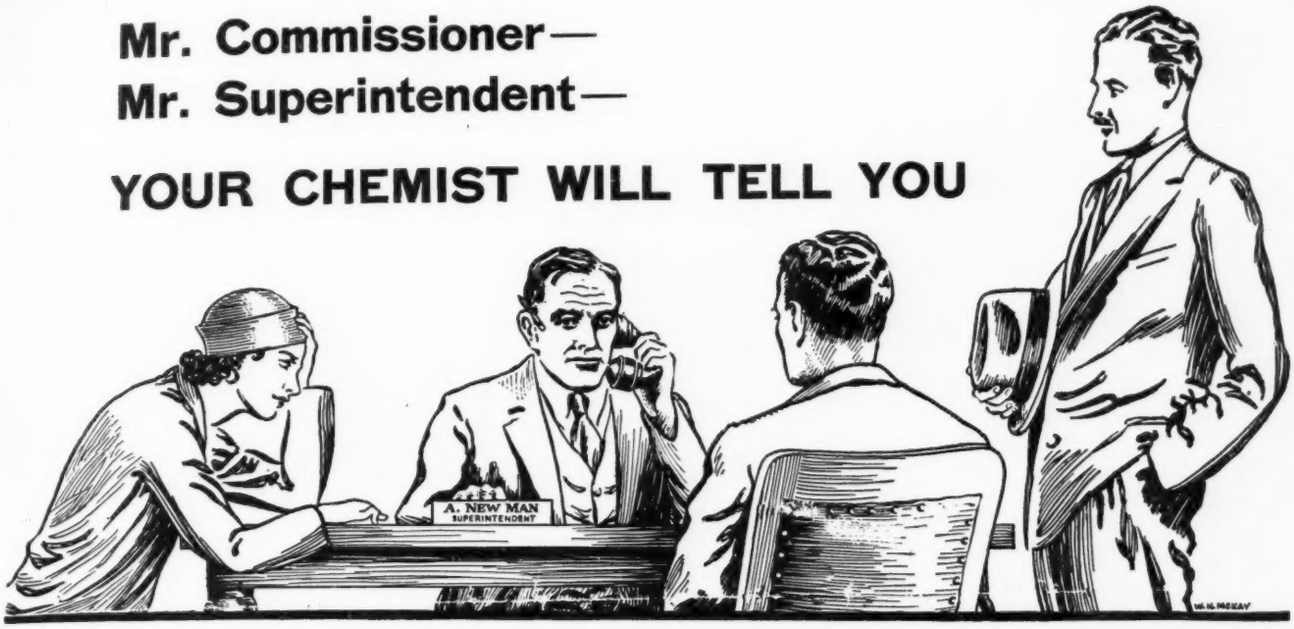


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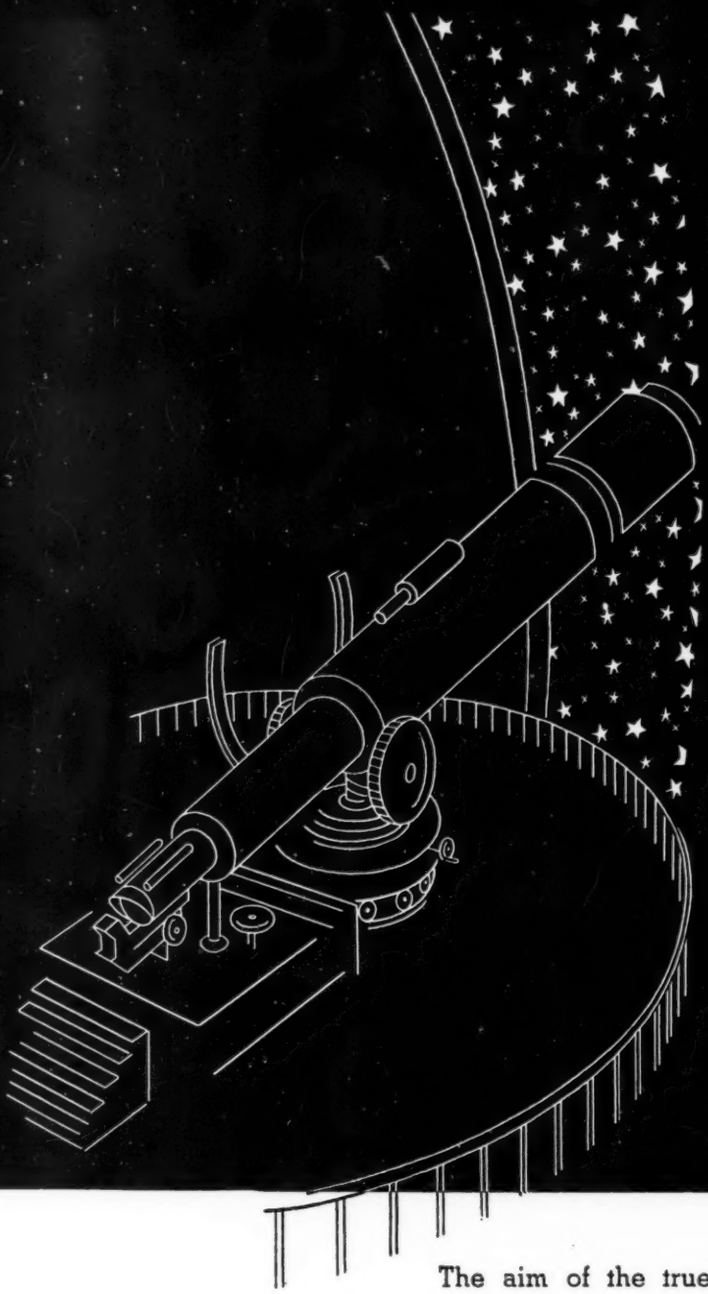

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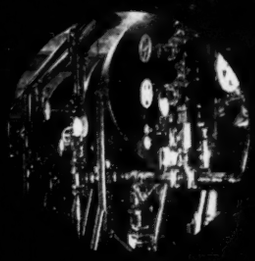

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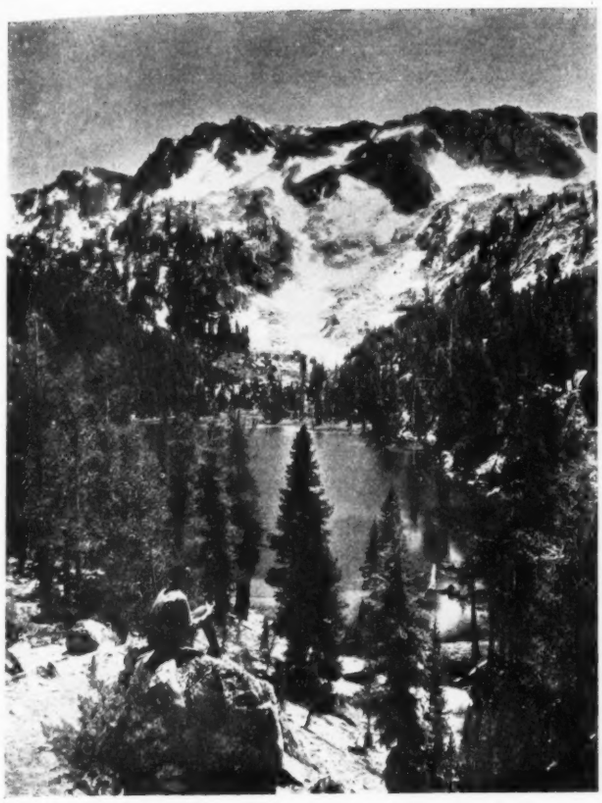


*One Source of Los Angeles Water Supply. One of the Twin Lakes in the High Sierras. Typical of Many Others That Feed Los Angeles 238-Mile Aqueduct with Melting Snows.*

# QUALITY OF LOS ANGELES WATER SUPPLY

## With Recent Experiences in the Control of Chlorination

By R. F. GOUDEY

*Sanitary Engineer*, Department of Water and Power, Los Angeles, Calif.*

THE illustration on the front cover of this issue pictures one of the Twin Lakes near Mammoth, California. It is but one of a myriad of small lakes tributary to the 238 mile Los Angeles aqueduct. This aqueduct was constructed by Mr. William Mulholland, formerly Chief Engineer of the Bureau of Water Works and Supply, and by his then assistant, Mr. H. A. Van Norman, now Chief Engineer of the Bureau.

*The Author*

The aqueduct system of Los Angeles drains the eastern slopes of the Sierra Nevada range, from Haiwee north 150 miles to the Mono Basin, and intercepts hundreds of mountain tributaries from rugged and precipitous cliffs which in places range up to 14,000 feet in elevation. The flow from the mountain snows and glaciers is equalized by gravel deposits in Owens Valley and by storage reservoirs at Tinemaha and Haiwee. The average annual yield of this system is 350 second feet. The aqueduct, with a capacity of 450 second feet, traverses more than 200 miles of scorching desert en route to the city—and, were it not for this supply Los Angeles, which is indeed in a desert country, would be totally unable to support its present population. In fact, this water is truly the "life blood" of the City of Los Angeles, Haiwee Reservoir is at about 4,000 feet elevation and between it and the city are several power drops generating electrical energy which is distributed by the Bureau of Power and Light under the Department of Water and Power.

The average person when drinking snow-water at the head waters of these mountain streams will invariably comment on how nice it would be if the water "as is" could be delivered to the consumer in Los Angeles. While there are certain modifications which occur in the water during its three months' storage and transportation period before delivery to the city, nevertheless a remarkably good and wholesome water is served to the consumers as is evidenced by the chemical and bacteriological analyses.

### Mineral Quality

The aqueduct water is made up from three sources. The first and principal one is melting snow from the High Sierras, which is extremely soft and highly desirable for domestic, irrigation and industrial purposes. The second source is from the run-off of the valley floors, which is due mostly to the melting snows in the winter and early spring, but this water is of somewhat

*Director of Laboratories and the Division of Sanitary Engineering.

*Character of the Country Through Which Runs Los Angeles Aqueduct. This Most Recent 30 to 94-in. Electric Welded Steel Line, Which Connects Boquet Canyon Reservoir with the Main Aqueduct, Regional Wall Thickness of 1 1/16 In. at Low Points. It Was Completed April, 1934.*

higher mineral content. The third source is the returned water (seepage) from irrigation on the valley floors. Such waters are naturally more mineralized, but since the purchase by the City of Los Angeles of irrigated areas in Owens Valley the volume of return irrigation waters into the aqueduct system is becoming negligible. For this reason the mineral quality of the aqueduct supply is certain to improve greatly. Storage in Tinemaha and Haiwee Reservoirs as well as that in terminal reservoirs in the City of Los Angeles, exposes the water to algae growth which, at times, produce slight tastes and odors in the water and changes somewhat the alkalinity of the supply. Evaporation in these reservoirs brings about a minor concentration but, what is more significant, the flow throughout the year is so effectively equalized that the water as delivered to the consumer is practically uniform. The reservoirs apparently are leaching out less and less mineral solids each year and the analysis of the aqueduct supply indicates a steady improvement. Table I gives the results of average recent mineral analyses from different sources and at different points on the aqueduct system.

TABLE I. MINERAL QUALITY OF WATERS—LOS ANGELES AQUEDUCT SYSTEM

| | Ca. | Mg. | Total Hard-ness | Alkalinity as $CaCO_3$ $HCO_3$ | $CO_3$ | $SO_4$ | Cl. | F.* | B.* |
|---|---|---|---|---|---|---|---|---|---|
| Mt. streams entering aqueduct system | 10 | 5 | 45 | 53 | 0 | 4 | 2 | 0.2 | 0 |
| Valley drainage entering aqueduct system | 48 | 10 | 160 | 190 | 10 | 100 | 22 | 1.0 | 1.5 |
| City delivered aqueduct water | 28 | 9 | 107 | 150 | 5 | 145 | 28 | 1.0 | 0.7 |

*F=Fluorine as fluorides. *B=Boron as borates.

The water as delivered to consumers, which has a hardness of about 100 p.p.m., is desirable for industrial commercial, domestic and irrigation use. With the still further decreasing in returned irrigation water from Owens Valley the hardness will probably drop gradually to about 75 p.p.m. It is interesting to note that when the city completes the Mono Basin project, which will add 138 second feet of mountain snow waters at the head of the Owens River system, the hardness in the combined waters delivered in Los Angeles should be between 50 and 60 p.p.m. This will give Los Angeles a permanent supply of soft water and put it in a better position to compete with other cities for industries requiring a softer water than has heretofore been available.

There has been some concern felt by irrigationists in San Fernando Valley over the boron content in the aqueduct supply. Investigations show that when certain lakes in the valley floor of Round Valley overflow into Owens River a sufficiently large amount of boron will enter the system during a two weeks period to give a boron content of 1 p.p.m. in the San Fernando Valley supply. It has been found that by timing the run-off from various reservoirs that the boron peak can be made to arrive in San Fernando Valley during the off-irrigation season. Mountain water from the Mono Basin project will supply sufficient dilution to overcome any of the present objections to the boron content of the valley waters.

The presence of free (basic) carbonates in the water gives protection to the distribution system but permits incrustation at the upper end of the aqueduct, consisting of lime skeletons of the Pestis fly, which materially cuts down the carrying capacity of the aqueduct. The periodic removal of these deposits appears to be cheaper than carbonation treatment to convert the carbonates to the bicarbonate form.

## Sanitary Chemical Quality

Naturally the snow run-off is exceptionally good from the sanitary standpoint. There are no sewers or sewage laden streams tributary to the aqueduct system. Vegetable organic matter may enter from the valley floor run-off and from growths in reservoirs. The Depart-

*Silver Lake Service Reservoir, Los Angeles, Showing Type of Storm Water Diversion Walls Constructed Around Terminal Reservoirs.*

TABLE II.—SANITARY CHEMICAL QUALITY OF WATERS—LOS ANGELES AQUEDUCT SYSTEM

| | D.O. | B.O.D. | Ox. C | $NH_3$ | $NO_2$ | $NO_3$ | Total Org. N. | $Co_2$ | pH | Color | Turb. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mountain streams entering aqueduct system. | 9.0 | 1.0 (or less) | 1 (or less) | 0 | 0 | 0 | <1 | 0 | 8.4 | Tr | 0 |
| Valley drainage into aqueduct system..... | 6.5 | 1.0 | 4.0 | .2 | Tr | 0 | 8 | 0 | 7.8 | 15 | 2.5 |
| City delivered aqueduct water..... | 8.0 | 2.0 | 2.9 | Tr | 0 | 0.8 | 2.5 | 0 | 7.9 | 15 | 2.5 |

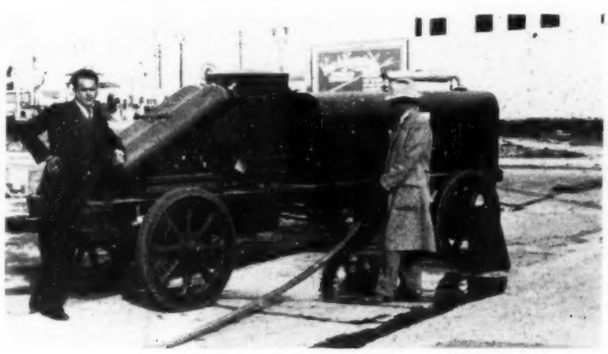
ment makes a practice of oiling the banks of reservoirs, keeping the margins free of vegetation, prohibits fishing, hunting and bathing, and seines excess fish from the reservoirs at yearly intervals. Table II gives the results of average sanitary chemical analyses.

The water at all times is practically saturated with oxygen, its biochemical oxygen is low, the nitrogens indicate little or no pollution even of a vegetable type, and the other characteristics meet the U. S. Treasury Department Standards.

Bacteriological samples are collected at different points along the entire aqueduct system. Practically all the inhabitable part of the watershed lies within the National Forest and is a natural playground for a large population, the permanent population being about three per square mile. Analyses of all the mountain streams entering the aqueduct system showed occasional presence of slight contamination, whereas, none of them are contaminated seriously. None of them contain any sewage, nor are they sewage laden. Storage in Haiwee Reservoir eliminates any chance pollution which might be present so that the water entering San Fernando Valley is at all times safe for drinking purposes without treatment. The main aqueduct supply enters Los Angeles through Upper San Fernando Reservoir in San Fernando Valley. This reservoir has a small watershed area around it from which storm waters are not by-passed. At times of storm the presence of B. Coli is noted in the run-off water, sometimes in all of the five 10 c.c. tubes used in a standard water test. Thirty days following the rain the water in these reservoirs is safe for drinking purposes without treatment. There is, however, another source of pollution—that caused by seagulls and pelicans. The effect of the seagull pollution is noted in the samples given below. After driving away the seagulls the water shows almost immediate improvement.

Samples for bacteriological analysis are taken before and after chlorination and the results shown in Table III shows how these samples meet the Treasury Department Standards. It is apparent, from a study of this table, that even the raw waters are fairly clean and free of serious contamination. The b. Coli index of the samples before chlorination is less than 2 per 100 c.c.

The city of Los Angeles began chlorination of the water supply in 1923. It soon developed plans involving carefully selected chlorinating points involving installation of the most advanced and modern chlorinating equipment. It was the first city to install as many as 26 full automatic chlorinators at its 13 stations and one of the earliest to make use of the one-ton chlorine container in specially designed stations to simplify handling.



*Los Angeles' Portable Emergency Chlorinator. Found Good Use Following the Long Beach Earthquake, March 10, 1933.*

*Griffith Park Station—Typical of Recent Los Angeles Chlorinating Stations.*

A residual chlorine machine designed to automatically control chlorine dosages based on the residual chlorine remaining in the water, has been thoroughly tested under varied conditions. Thus the chlorine is varied to cover both variations in flow and in chlorine demand of the water. Our studies have indicated that such variations are material and only the residual-chlorinator can give the quality of chlorine control which is so much to be desired. It is proposed now to equip two other important stations with standard residual chlorine control equipment.

Before the aqueduct was completed the water supply for the city of Los Angeles was obtained from galleries and wells in the Los Angeles River. These galleries and wells are divided into two groups supplying two gravity pipe lines (totaling 26 miles) which feed three terminal reservoirs. A chlorination station was established near the upper end of these gravity lines, but the residual chlorine disappeared 1,500 feet below the plant and slight contamination apparently entered between this point and the terminal reservoirs. A second chlorination plant was constructed at the end of one of these gravity lines to treat the water entering one of the terminal reservoirs.

Ammonia treatment ahead of chlorination was tried out a year ago for the purpose of determining whether or not residual chlorine could be carried through from the upper end of the lines to the terminal reservoir. Automatic ammoniators were installed for this purpose and it was at once found that with an application of 2½ to 3 lbs. of chlorine per million gallons and ⅓ to ¼ that quantity of ammonia a chlorine residual of 0.3 to 0.5 p.p.m. could be maintained through the gravity lines to the terminal reservoirs, the maximum distance being 4¼ miles. Success with the chlorine-ammonia treatment has eliminated two chlorine stations and the bacteriological analyses water samples taken over the treated area have shown marked improvement.

TABLE III.—BACTERIOLOGICAL QUALITY OF WATERS—LOS ANGELES AQUEDUCT SYSTEM

| | Total Samples | —3 or More Tubes Positive— No. of Samples | % of Samples (5% all'd) | ——Portions Positive—— Total No. of Portions | No. of Portions | % of Portions (10% all'd) |
|---|---|---|---|---|---|---|
| Mountain streams entering aqueduct system. | 72 | 20 | 27.80 | 360 | 111 | 30.50 |
| Samples before chlorination..... | 1356 | 229 | 16.90 | 6780 | 1167 | 17.20 |
| City delivered aqueduct water..... | 4027 | 18 | 0.45 | 20135 | 268 | 1.33 |

# A YEAR'S OPERATION OF SMALL GAS ENGINES

By JAMES R. RUMSEY

*Supt., Sewage Treatment Works, Grand Rapids, Mich.*

THE purpose of this article is to describe briefly the operation of small gas engines, using sludge digester gas as a fuel, during fifty-two weeks of service, at the Grand Rapids Sewage Treatment Plant.

*James R. Rumsey*

For a more detailed study of the application of gas utilization for larger engines we refer the reader to the report by W. B. Walraven, District Engineer, Springfield, Ill., published in WATER WORKS AND SEWERAGE, May, 1933, and also to his second report after one year's operation.

During the construction of the Grand Rapids Treatment Works, in the summer of 1930, a decision was made by the engineering staff to aerate deep inlet channels to the clarifiers (see plant picture) in preference to the installation of false bottoms. The channels had been designed looking toward the introduction of waste activated sludge at a later time. There appeared to be three reasons for aerating the channels: to keep the settleable solids in suspension until they passed through the high inlet ports into the clarifiers; the demulsifying or liberating of entrained hydro-carbons so the resultant floating grease could be skimmed; and the absorption of some oxygen for odor control. We believe the last has some merit but has been difficult to prove by laboratory test.

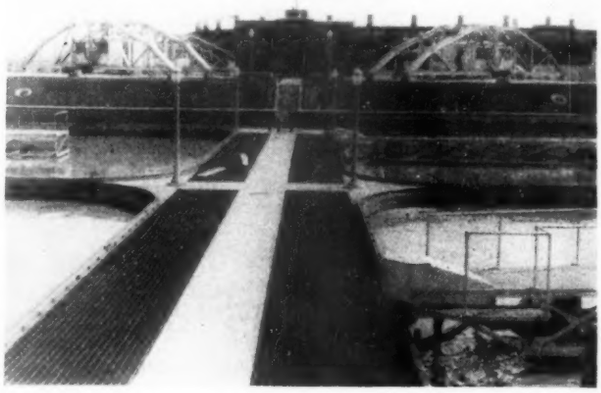
Porous air diffuser plates were installed in the inlet conduits as originally designed, and piping connections made for connecting with a motor operated blower.

*Blower House, Grand Rapids Sewage Treatment Plant. Motor-driven Unit on Left, Gas-driven Unit on Right*

A Root's rotary blower, direct connected to a 15 h.p., 480 volt, 60 cycle motor turning at 575 r.p.m. at full load was purchased. This blower has a rated capacity of 600 cu. ft. of free air per minute when developing a pressure of 3½ pounds per square inch. The installation was so made that it allowed for the addition of placing a duplicate or stand-by unit.

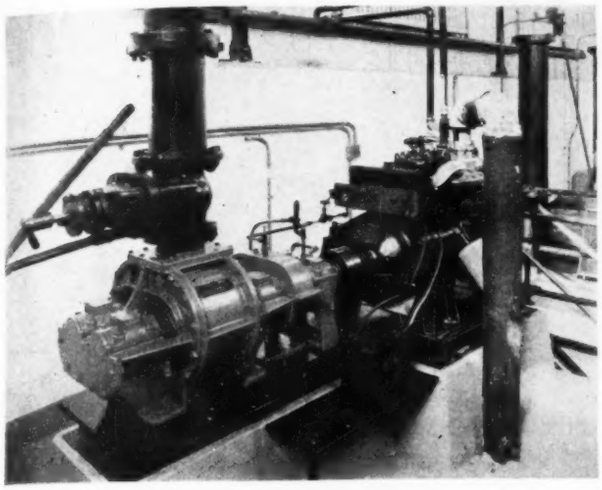
## Connersville Blower and Buda Gas Engine Installed

Provision was made in the estimate of additional equipment to cover installation of the duplicate unit. The purchase price of the original installation was $935.00 and a like amount was ear-marked for the duplicate unit. The equipment was not purchased, however, for two years, and in the meantime a decision was made to install a gas-engine driven blower of the same capacity. Consequently, in December, 1932, an order was placed for a Connersville blower, gear connected to a Buda engine.



*The Grand Rapids Plant Aeration—Distributing Channels Between Clarifiers in Center Ground*

The Connersville blower is 8 by 9½ and giving 0.725 cu. ft. displacement per revolution. The Buda engine is a 4 cylinder, 4 by 5¼ inch bore and stroke, with 263.9 cubic inches piston displacement, equipped with a generator and storage battery for actuating a motor starter of the automotive type. The generator, now after a year's use, is being removed and a Robt. Bosch magneto is being installed on the left side of the engine, to eliminate generator trouble now beginning to develop on account of bearing deficiencies. It also includes a governor to prevent racing if for any reason the load should be removed. The engine has, mounted on the rear end, a small two gallon tank for feeding gasoline to a carburetor for starting or for running on gasoline if desired. Also, behind the gas tank, is a control board mounted on which is a switch, starter button, oil pres-



*Buda Gas Engine Driving Connersville Blower at Grand Rapids, Mich., Sewage Treatment Plant*

sure gauge, spark and throttle control, choke, ammeter, etc.

The intake manifold on the right side of the engine is connected to a carburetor and on the air intake of the carburetor is the gas mixing valve. The air intake has been extended and equipped with an air cleaning filter, which is home-made.

The gas line is equipped with a pressure regulator. A vertical ball-check valve to prevent back pressure pulsations on the gas line, is a desirable addition to be inserted in this line.

Cooling water lines are equipped with thermometers, the water being taken from and returned to the hot water heating system.

## Operating Service Records

This equipment was installed on March 21, 1933, and observed carefully for study up to and including March 12, 1934. The actual running time during this period amounted to 87.5 per cent of the elapsed time, or 7,519.5 hours. The unit was idle for 1,087.5 hours, or 12.5 per cent of the total elapsed time.

Of the 1,087.5 hours idle time, 44.3 per cent, or 478 hours, were caused by mechanical difficulties in the gas engine itself. This trouble involved the various parts peculiar to engines, such as rings, bearings, generator, battery, valves, coils, points, clutch, switch, etc. Air blower oil pump defects required attention and caused 322.5 hours of the shut-down time, or 29.9 per cent of the total idle time. Gas supply being cut off for various purposes in plant operation caused an idling time of 162 hours, or 15 per cent, while the shut-down time from miscellaneous causes was 116 hours, or 10.8 per cent.

Just by way of comparison it may be interesting to mention that were this engine installed in a five ton motor truck, with the R.P.M. at 920, the equivalent speed in high gear would be 30 miles per hour. If operated according to H. T. Horton's regulations for heavy transport, consisting of 8 hours per day and covering 200 miles, 3 years and 8 months elapsed time would have been required to use up the 7,915.5 hours actual running time. The equivalent mileage of 225,600 miles is equal to circumventing the earth nine times.

## Economics of the Project

The total investment required for this installation, including blower, engine, valves, air filter, magneto, gas regulator, fittings and freight was $1,453.43.

A motor driven blower, to deliver air pressure for the same period of time, would have cost 2.058 cents per K.W.H. for 2,000.75 hours, or $422.03 from March 20, 1933, to June 24, 1933. A reduction in rate was obtained on the latter date which placed the cost at 1.132 cents per K.W.H. For the remaining 5,518.75 hours of the total running time in the period considered the power cost would have been $640.34, making a total of $1,062.37 in the cost of electrical energy to operate the motor driven blower for the entire 7,519.5 hours.

### INVESTMENT

| | | |
|---|---|---|
| Connersville blower with Ruda engine | $1,173.10 | |
| Freight | 26.14 | $1,199.24 |
| Two 6 inch valves | 39.10 | |
| Freight | .90 | 40.00 |
| Air filter | | 109.15 |
| Cast-iron fittings | | 50.62 |
| Initial investment to March 20, 1933 | | $1,399.01 |
| Bosch magneto and gas regular | | 54.42 |
| Total investment to March 12, 1934 | | $1,453.43 |

### OPERATION

| | | | |
|---|---|---|---|
| Running time through March 12, 1934 | 7,519.5 hrs. | | 87.5% |
| Idle time through March 12, 1934 | 1,078.5 hrs. | | 12.5% |
| *Shut-down—Mechanical* | | | |
| *Blower Trouble* | | | |
| Blower oil pump defects | 322.5 hrs. | | 29.9% |
| *Engine Trouble* | | | |
| Motor rings and bearings | 173 hrs. | | |
| Generator | 158 hrs. | | |
| Battery | 39.25 hrs. | | |
| Ignition | 33.50 hrs. | | |
| Coils | 4.50 hrs. | | |
| Breaker points | 4. hrs. | | |
| Grinding valves | 7.25 hrs. | | |
| Change of oil and checking | 35.75 hrs. | | |
| Miscellaneous—clutch, switch, magneto, valves, thermometers, conduit | 22.75 hrs. | 478 hrs. | 44.3% |
| Total Mechanical | | 800.5 hrs. | 74.2% |
| *Shut-down—Physical* | | | |
| *Gas Trouble* | | | |
| Supply, water and sludge in line, cleaning boiler | | 116 hrs. | 10.8% |
| *Other Shut-downs* | | | |
| Painting, etc | | 162 hrs. | 15.0% |
| Total Physical | | 278 hrs. | 25.8% |
| Total Idle Time | | 1,078.5 hrs. | 100% |

### SAVING

| | |
|---|---|
| Running time [3-20-33 through 6-24-33] = 2,000.75 hrs. at 10.25 k.w.h. per hr. = 20,507 k.w.h. at $.02058 per k.w.h. | $ 422.03 |
| Running time [6-24-33 through 3-12-34] = 5,518.75 hrs. at 10.25 k.w.h. per hr. = 56,567 k.w.h. at $.01132 per k.w.h. | 640.34 |
| Total Power Saving | $1,062.37 |

### EXPENSE

| | | | |
|---|---|---|---|
| *Lubricating Oil* | | | |
| To 7-25-33 | 35¼ gals. at 50.1c | $17.66 | |
| To 1-8-34 | 44⅜ gals. at 41.1c | 18.24 | |
| To 3-12-34 | 17½ gals. at 36.1c | 6.32 | |
| | 97⅛ | | $42.22 |
| *Supplies and Repairs* | | | |
| 8-30-33 | 6 Delco Remy generator brushes | $ .47 | |
| 9-8 | 1 Generator bearing | .68 | |
| 11-7 | 10 Bosch high heat plugs | 5.00 | |
| 11-28 | 12 Piston rings | 4.40 | |
| | 4 Oil rings | 2.73 | |
| | Babbit rod | 2.94 | |
| 2-10-34 | Repair generator | 13.33 | 29.55 |
| *Carrying Charge* | | | |
| 7⅝ per cent on $1,453.43 | | | 110.82 |
| Total Expense | | | $ 182.59 |
| Net Saving First Year | | | $ 879.78 |

The expense involved in the operation of the gas engine blower for the first year included lubricating oils, supplies and repairs, and a carrying charge of 7⅝ per cent on the total investment of $1,453.43. The total expense, therefore, was $182.59, and this figure deducted from the total power saving of $1,062.37, makes a net saving of $879.78. This figure could be further increased were we to include the salvaging of oil from this engine. Re-filtered oil is used in slower-moving, heavier units, thus affording an economy which is not evaluated here.

LIFE

| | |
|---|---|
| Total investment to March 12, 1934 | $1,453.43 |
| Net saving first year | 879.78 |
| Balance end of first year | $ 573.65 |
| $573.65 at 7⅝ per cent carrying charge = $43.74 | $3.65 per mo. |
| Other expenses will be $71.77—averaging | 5.98 per mo. |
| Total average monthly expense | $9.63 per mo. |

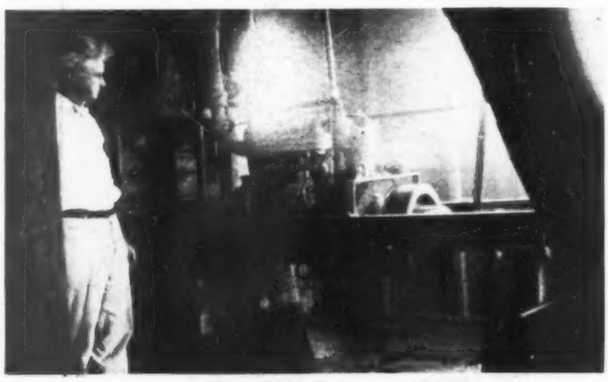
77,074 k.w.h. anticipated in 12 months = 6,423 per month.
6,423 k.w.h. × $.01132 = $72.71 saving per month, estimated.
$72.71 saving, less $9.63 expense, gives a net saving of $63.08 per mo.

Investment balance (end of the first year) of $573.65 divided by $63.08 gives 9 times, or 9 months and three days to liquidate investment cost.

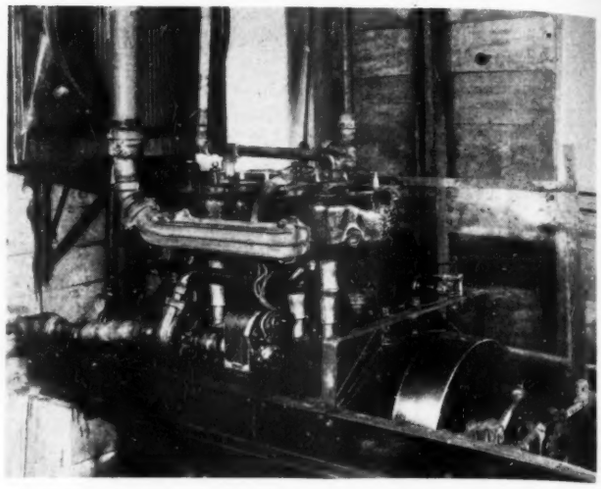
The estimated life of this unit is based upon the liquidation of the total investment involved. Deducting the net saving of $879.78 from the total investment leaves a balance to be liquidated of $573.65. Continuing a 7⅝ per cent carrying charge for this balance would mean the liquidation of $43.74 per year, or $3.65 per month. Based upon the first year's experience during which there was an expense of $71.77 for lubricating oil, supplies and repairs it would mean an additional $5.98 per month for operating. The total average monthly expense, therefore, including the carrying charge, would be $9.63.

## Investment Liquidated in 1.75 Years

Estimated on past experience a total of 77,074 K.W.H. would be required over a twelve month period for the necessary air pressure by motor-driven blower. This would cost, at the new low rate for current, $72.71 per month. Deducting from this power saving the total monthly cost of $9.63, would leave a net saving of $63.08 per month, which if applied to the balance of $573.65 to be liquidated, would require 9 months and 3 days. Thus the entire investment of $1,453.43 for gas engine and blower will require one year, nine months and three days for liquidation. You may not agree with our theory of financial setup as herein given, but at least you will concede that the little engines are more than paying their way, and also are helping to prove that digester gas is a valuable asset and should be utilized to its full capacity.



*Gas-Operated Engine in Fertilizer Plant (Mr. Rumsey in Left Foreground)*



*A Salvaged Gasoline Engine Converted to Run on Sludge Gas—Developing Power to Operate Fertilizer Plant at Grand Rapids, Mich., Sewage Treatment Works*

## Fertilizer Plant Run With Gas Motor

During the season of 1932 the fertilizer plant was powered entirely by electric motor. During the time the study was being made for the new blower installation, thought was also being given to the possibility of operating the fertilizer plant by gas engine power. Consequently, a Wisconsin Motor, abandoned by the Highway Department, was secured and rebuilt for use in the fertilizer plant. This motor is a 4 cylinder 5¾ by 7 inch engine, turning at 700 r.p.m. We equipped it with a governor, air filter, magneto, mixing valve, gas regulator, etc., to adapt it to the use of sludge gas as fuel. It is sufficient to meet all power requirements for the plant, developing approximately 50 brake h.p. at this speed.

## A Few Comments

The following comments may be of interest to you if you desire to operate small gas engines with methane gas. A greater compression ratio is required than for gasoline vapor. The gas must be fed to the mixing valve under a constant pressure. The mixture of gas and air is very exacting and must be closely regulated. The spark plugs should be of a special type, resistant to high heat. Sufficient radiating capacity should be provided. In other respects the operation is very similar to that of any engine burning gasoline vapor.

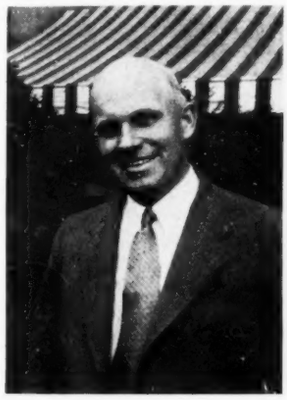
The few figures we have given are, we believe, sufficient to show the economies possible with small engines if gas is available, without taking into consideration the possibilities of the recovery of heat. We expect in the future to utilize the waste heat from the burned gas in the blower house for heating that building, and this year the exhaust from the Wisconsin engine will be discharged into the dryer drum in the fertilizer plant, thus recovering this waste heat for a useful purpose.

*Acknowledgment.*—This paper was presented before the 10th Annual Conference of the Michigan Sewage Works Association.

# SELECTING THE RIGHT METER

By ROGER W. ESTEY

*Superintendent, Danvers Water Works, Danvers, Mass.*



*The Author*

IN DAYS gone by, the thought of "What shall we set for a meter on any service line?" was not given the consideration warranted. The expense involved apparently did not appear to be a factor, because the size of the pipe installed was generally used as the determining factor in selecting the size of meter for the installation.

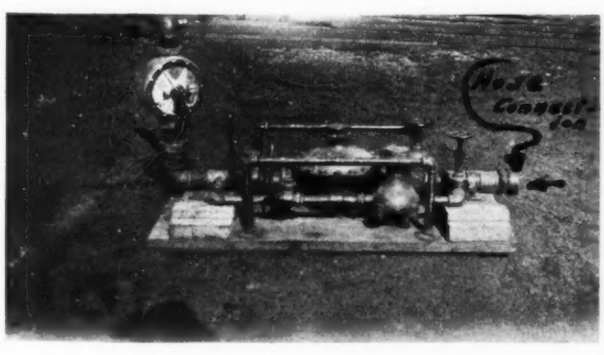
Since those days meters have reached a much higher degree of perfection and now, at reasonable cost, meters can be purchased to fit any service required; and, can be depended upon to give satisfactory results.

Especial care should be exercised when purchasing a meter because this device serves as the cash-register of the system. When purchasing a meter do not let the price be the determining factor; for, as you know, the older we get the more and more do we realize that you get just about what you pay for. There is no such thing, nowadays, as truth in a claim that "It is just as good for one-half the price."

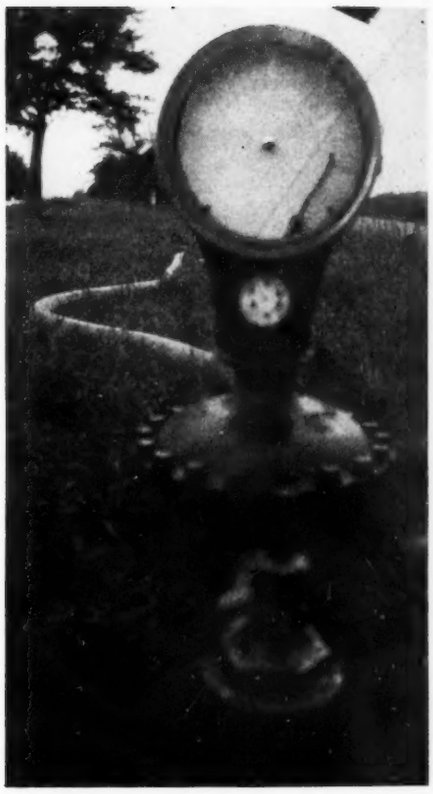
We must not forget the obligation we owe to those we serve. We must not spend their money recklessly or unwisely.

Several years ago, at Danvers, we had a water waste survey made to check up on our consumption, which apparently was gradually creeping upward without any particular reason. Much to our surprise, we found no unreasonable leakage, but found that all of our large meters were under-registering, some as much as 50 or 60 per cent. On large meters this constitutes a sizeable and serious loss.

In the past, we never tested these meters, and as long as they kept running and the monthly readings were comparative, little, if any, attention was given them. Then when we found a stopped one we would take it apart and clean it and make whatever repairs that might be necessary. We didn't know whether the meter recorded accurately or not. We merely assumed that if it was properly cleaned and repaired it must be right.



*Portable Meter Testing and Flow Measuring Outfit Used in Field Tests for Meter Accuracy or Size of Meter to Be Installed. Danvers (Mass.) Water Department.*



*A Neptune Indicating and Recording Meter Set, Used in Evaluating Variations in Water Takings by a Customer and Determining the Proper Capacity of Meter to Be Set. Danvers (Mass.) Water Department.*

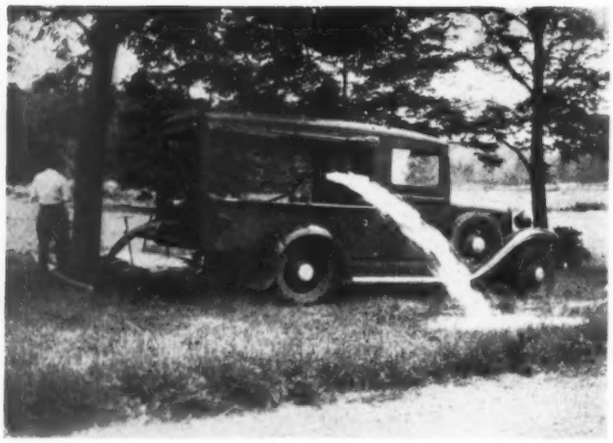
After our water waste survey we changed practically every meter or had them rebuilt. As time went on, we found that this change had been very unsatisfactory. We were suspicious of the accuracy of the readings of one meter, realizing that they must be too low. To obtain a test on it, we put in two one-inch corporations bringing them together, and then from this junction extended a fire hose to a two-inch test disc-meter which had been previously checked for accuracy. From this set-up approximately 200 G.P.M. was obtainable. Apparently our suspicions had been right because we found the meter under-registering. As a result of that test, we started tapping in just beyond all of the other large meters for additional testing.

## Meter By-Pass Lines Proved Their Worth

From the results of this work, we decided to take out all of our institution and industrial meters, replacing them with new meters. In each case we provided a by-pass line, a test tee and the necessary gates, so that tests and repairs could be made at any time without inconvenience to the customer.

In my opinion the money spent constituted the best investment we have ever made for convenient and money saving maintenance. It is a highly justifiable expense and no meter of any consequence should be set without being by-passed, properly gated, and a test plug inserted.

We made mistakes in our first set-up that I would correct if I was doing the work over again. In making changes my first correction would be to set the meter on the by-pass, line and leave the main line unobstructed, to take care of large emergency demands such as would be needed at a fire. As a general rule, a meter much smaller than the size of the supply pipe can be, and



*Portable Meter Testing Outfit on Service Wagon. Connection is Made by Fire Hose to Meters Tested. Danvers (Mass.) Water Department.*

should be used and there is also a saving to be had in the cost of the smaller fittings. This is now the practice followed.

Then, next, all gates should be provided with rising stem valve. There is a possibility of leaving gates opened or closed where the standard (non-indicating) gate stem is used. Visualization is a great safeguard and protection and at a glance one can tell the position of a rising stem valve.

## Oversize Meters—Why?

After this new set-up of meters had been in for a few years, we made a 3 or 4 day test on each meter, running the testing device twenty-four hours each day. The results were surprising—even astounding. Meter line requirements on 6 and 8-inch pipe lines, provided with meters of the same size as the pipe, showed that at no time did the demand exceed on the 6 inch meter 25 G.P.M. and on the 8 inch meter 75 G.P.M.

From these results it was apparent that: In the first case a ¼ inch meter would amply take care of the normal demands and in the second instance a 1¼ inch meter would suffice. But, these meters were on lines supplying hydrants, and therefore the smaller meters could not be used. It is my opinion, however, that a 4 inch meter—if not a 3 inch meter—will prove ample. A 3 inch meter on a by-pass will supply two powerful fire streams and in most cases this will be sufficient. If a greater demand should be required the main line can be opened. Since we have a man who answers every fire alarm, he has been instructed in every instance to open up the gate on the unmetered side, regardless of how small the first might be.

We have had these smaller meters in now for nine years and we have only opened up the unmetered side of the line once. At this fire only one stream was used, but the gate was opened just the same. No difference was noticed in the volume in this instance, where a 3 inch meter had been cut into a 6 inch line leading from an 18 inch main.

When laying a service main I thoroughly believe in laying one that will more than take care of the service demanded. Larger lines reduce friction and deliver volume up to the point of the demand. The owner should be interviewed regarding what he feels will be his maximum demand in gallons per minute. On commercial lines, I try to have the customer visualize a barrel and then tell him that that barrel holds 50 gallons, how much more or less than 50 G.P.M. will he use? He can readily make a comparison in his mind between the 50 gallons and the amount he is going to use and he can then easily judge about how much he will use, and it is seldom you will find any user using more than 50 G.P.M. Cubic feet means nothing to the customer, and even gallons per minute hardly means anything, but the barrel method of determining the amount of water he might use, is much easier for him to understand and has not failed yet in giving to me the information that I have wanted in determining the size of meter for the service.

The type of service and demand, should be instrumental in determining the type of meter that should be used. Consideration of the small flows should be given prior consideration because 90 per cent of the flows come under the range of the smallest capacities of the large meters. If a large continuous flow is used, then naturally a meter to register large flows should be used as there are no small streams to be considered.

I have a case in my own system, at Danvers, where all of the water is repumped and this pump operates at about 500 G.P.M. until the tank is full, then it automatically shuts off and no more water passes through the meter until the level of the tank drops sufficient to kick in the automatic pump switch. In this case a meter to pick up minor flows, leakage, etc., is not needed, because the rate of flow is 500 G.P.M. or nothing.

The selection of the meter, should in my opinion, be left with the water works officials and not to the customer. The ownership of the meter should also be retained by the water department and not by the customer. By experience, water works managers are much better qualified than anyone else to select the proper meter which, in justice to all, must be the most adaptable to the desired type of service it is selected for.

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## Private Financing of Public Works Returns to Favor

Thirty-four municipalities, more, have recently notified the P.W.A. that private capital now being made available renders it unnecessary to borrow government monies. Although taking the 30 per cent grant, such private financing has thereby released almost $2,000,000 to be utilized for additional P.W.A. grants or loans.

At this writing the total number of municipalities finding private capital ready for economical use has mounted to 316 and the sums ear-marked by the P.W.A., which have been consequently released for new allocation, amounts to very nearly $35,000,000 for use on other projects now on the waiting lists.

Sales of municipal bonds by R.F.C. and P.W.A., to banks and trust companies, starts a revolving fund to perpetuate P.W.A. financing. And, indicative of the soundness and desirability of municipal bonds held by P.W.A., a recent sale of 9 issues ($3,482,000) drew 56 bids and sold at a premium of almost 3 per cent above their face value; i. e., above the price paid for them by P.W.A. Also is this indicative of the improved status of municipal bonds in the eyes of private financiers.

Furthermore, St. Paul and Minneapolis have found private funds available at 3.5 per cent for financing the Twin Cities sewerage project—thus releasing another $18,000,000 of P.W.A. money and causing P.W.A. to reduce its 4 per cent interest rates to correspond with the St. Paul-Minneapolis figure.

# FIRST MEETING OF VIRGINIA SECTION, A. W. W. A.

## And Conference of the Virginia Sewage Works Association

THE newly created Virginia Section of the American Water Works Association held its first annual meeting at Martinsville, Va., July 12-14, 1934.

The Virginia Water and Sewage Works Association in 1933 reorganized as the Virginia Section of the A. W. W. A. and the Virginia Sewage Works Association —the two associations to have the same officers and hold their meetings jointly henceforth.

Officers chosen for the ensuing year are:
Chairman—D. R. Taylor, Roanoke, Va.
Vice Chairman—R. W. Catlin, Farmville, Va.
Secretary—H. W. Snidow, Richmond, Va.
Treasurer—C. F. Bingham, Richmond, Va.

E. F. Dugger of Newport News, Va., continues as the section representative on the Board of Directors of the A. W. W. A., and M. C. Smith of Richmond, Va., was re-elected as member of the Executive Committee.

The 1935 meeting is to be held in Roanoke, Va., and it was announced that a prize award would be presented at this meeting to the operator who, during the year, obtains the greatest improvement in conditions and operation at his plant.

### Entertainment Unique

The city of Martinsville entertained members and guests of the two associations in a novel manner. A golf tournament at the Country Club (H. J. Siebert, low gross) was followed by a picnic supper, in genuine Southern style, held at Martinsville's large and unique swimming pool located on a high hill surrounded by distant mountain scenery of rare beauty. Many attending enjoyed the pool before supper and then followed dancing on the pool plaza during the remainder of the evening.

### Technical Sessions

(Chairman—B. S. Parrish, Supt. Water & Light, Martinsville, Va., presiding.)

A highly interesting and valuable feature of the meeting was the review of E. F. Dugger, Section Director of the A. W. W. A., in which he reported on developments of importance during the recent convention of the A. W. W. A. and recounted the most interesting parts of technical papers and discussions presented on the floor.

*D. R. Taylor, Superintendent Roanoke Water Co., Chairman-Elect*

*H. W. Snidow, Engineer State Department Health, Secretary of the Section*

Methods of mapping and keeping records of existing water-mains, valves, hydrants, and services up to date, constituted a topic of considerable practical value to superintendents of water works. The system employed at South Boston, Va., was reported on by P. F. Johnson, Supt. of Water Works, was followed by a blackboard demonstration by B. S. Parrish of the style of key maps and detail section maps prepared to cover the Martinsville system. He also demonstrated the use of the magnetic dip needle and wireless type of detector for locating service pipe, mains and valves, which had proven very helpful in preparation of records. Fontaine Jones told of practices followed in keeping records covering the distribution system in Richmond, Va. D. R. Taylor said, that in Roanoke, the practice of universally laying water mains one-third the street width from the north and east property lines and installation of all meters on curb lines was very helpful in quick and easy location of mains. All valve locations had been carefully mapped.

In the various discussions, the value of standardization in respect to makes of equipment used on distribution systems was stressed—making for simplification in both maintenance, repairs and record keeping.

**"Effect of Temperature and Hydrogen Ion Concentration on the Efficiency of Chloramine and Chlorine—** Lois Frayser, Bacteriologist and Assistant Chemist, Filtration Plant, Richmond, Va.

Miss Frayser's paper recounted the results of carefully controlled laboratory experiments in which the findings disclosed that the pH effect, heretofore considered of high importance in affecting the rate of b. coli kill when using the ammonia-chlorine (chloramine) process of sterilization, was of little significance in the Richmond studies. On the other hand the lowering of temperature, regardless of the pH value, was found to be of high importance in retarding rates of sterilization and lowering efficiencies when ammonia was added

*"Chris" Bingham, Manager Filter Plant, Richmond, Va., and Treasurer of the Section*

*Eugene F. Dugger, Manager Water Commission, Newport News, Va., and A. W. W. A. Director*

prior to the chlorine—this being so even after very long periods of contact. The conclusions reached were: (1) When the pH value of the water (James River) was varied between 6 and 9 there appeared to be no difference in the effectiveness of chlorine or of chloramines in their rate or ultimate efficiencies in total bacteria and b. coli destruction. (2) A chlorine to ammonia ratio of 3 to 1 and a residual of 0.6 p.p.m. at 4 deg. centrigrade seemed to take a matter of days for sterilization as compared to a matter of hours to accomplish the same results when the temperature ranged between 32 and 37 degrees centrigrade.

In selecting 0.6 p.p.m. residual chlorine such had been done because this quantity represented the maximum which could be carried without taste production when using the ammonia-chlorine treatment. They had found that the pH changes between 6 and 9 had no more effect on the efficiency of ammonia-chlorine than on chlorine alone. From the findings it was their conclusion that, with prechlorination for certainty of disinfection, as practiced at Richmond, and thereafter the addition of the ammonia and chlorine to the filter effluent for additional benefits on the distribution system, the combined practice was a dependable one. Otherwise in cold weather the ammonia-chlorine alone could not be relied upon to continuously produce a water free of b. coli before reaching the consumer—even after considerable periods of contact.

**"Review of the Uses of Activated Carbon in Water Treatment"**—F. E. STUART, Industrial Chemical Sales Company, New York City.

Mr. Stuart brought up to date the practices of using powdered activated carbon for taste and odor control and presented a resume of experiences of numerous operators. He believed that the most effective practice involved prechlorination and the addition of carbon to the raw water. Auxiliary applications just ahead of the filters, when the taste and odor situation became severe, was desirable in addition. In starting carbon application to the raw water it was a distinct advantage to "seed" the filters with carbon, at the same time, by adding some of the filter influent water. Prevailing best practice involved the addition of between 5 and 10 lbs. per million gallons to the raw water with prechlorination and an additional 2 p.p.m. just ahead of the filters in the more severe cases. The advantages of carbon application to the raw water included improved coagulation and prevention of putrifaction of sludge deposits in the basins. Of the plants reporting, 81 per cent had found less than 20 lbs of carbon per m.g. sufficient; whereas, 32 lbs. per m.g., if split between the raw and settled water entering the filters, would prove sufficient for all but the very worse cases. He referred to studies under way wherein carbon added to the wash-water, for the purpose of impregnating the filter bed, showed promise of increased filter efficiencies and of maintaining the sand bed in a cleaner condition.

E. F. DUGGER, Manager, Water Commission, Newport News, Va., complimented Mr. Stuart on the method of presentation of the subject and said that powdered carbon was first used at the Newport News plant in 1930 and had been ever since in conjunction with prechlorination. He was now planning to utilize ammonia-chlorine treatment on the effluent to combat corrosion and dead end complaints.

H. A. JOHNSON, Superintendent of Filtration, Danville, Va., reported that the split application of carbon has served more effectively than other schemes tried at his plant. All the carbon added to the raw water had not given satisfactory results and all at the filters had shortened filter runs too greatly. Adding 40 lbs. per m.g. to the raw and 1 lb. per m.g. to the applied water had proved the best combination.

E. H. RUEHL, Town Manager, Bluefield, Va., had found the most effective treatment to comprise heavy prechlorination with but 4 p.p.m. carbon applied at the filters.

C. F. BINGHAM, Manager of Filtration Plant, Richmond, Va., explained the Richmond batch-method of applying approximately 8 lbs. of carbon direct to each filter unit of 3 m.g.d. capacity immediately after every wash. This small application, on the average, remained effective during a 24 hour run, thus reducing carbon consumption to less than 0.5 lbs. per m.g.

W. S. RUSSELL, Engineer of Water Works, Salem, Va., reported the successful use of carbon in raw water at intervals in addition to the continuous application at the filters.

Others present offered additional evidence of the dependability of the powdered carbon treatment, which appears to have thoroughly established itself as a valuable adjunct in water treatment practice.

*Hugh B. Rice, City Collector, Staunton, Va.*

*H. A. Johnson, Superintendent of Filtration, Danville, Va.*

## Meter Reading and Billing Practice

**"Methods of Meter Reading, Billing and Collecting"**—HUGH B. RICE, City Collector, Staunton, Va.

Mr. Rice related methods employed at Staunton, Va., in reading meters, billing consumers and collecting; displayed the several record and bill forms used. He said that collections had been better since changing from quarterly to monthly billings because, the more frequent small bills appeared less burdensome to pay. The city of 12,000 population had 2,700 accounts carried in 15 route books for meter reading by the stagger system—each page in the book being sufficient for 24 monthly readings and record of repairs, size, number and make of meter. The reader computes the consumption and, if abnormal, leaves a notice with the customer and makes a special report to the office. In billing, one clerk turns out 500 to 800 bills per day by the use of the "stub office copy" system. All bills were delivered by a Water Department employe and, after 10 days of non-payment, a notice was sent or telephoned to the delinquent. Then followed the "work-order" (on simplified form shown) to discontinue service—the same carrying the order to renew service after the bill and 50 cent service charge had been paid. Partial payment of bills had been accepted where necessary.

Complaints were all handled through the City Collector's office—promptness of attention and courtesy being the motto. In cases of excessive bills a careful check up was made and refund allowed when proper.

Meters are often checked at the curb with a recording chart meter, connected in series with the consumer's meter, to convince him of the accuracy of his meter or to prove existence of leaks. Applications for service, he said, were handled by a recently simplified system and applicants outside of city limits agreed to a rate 50 per cent higher than the city rate.

**"Mechanical Aids to Office Management in Small Municipalities"**—W. P. ADAMS, Burroughs Adding Machine Company, Detroit, Mich.

Mr. Adams being unable to attend the meeting, this topic was presented by R. C. Wagner, of the same firm. He called attention to the recent marked developments in mechanical computing, record making and billing equipment for small as well as large offices. The time saving feature was usually a more important factor in small undermanned offices than in large ones and the accuracy of mechanical equipment prevented costly errors and time required to find and rectify mistakes made under pressure. Aside from the accuracy features and doing away with the personal element, it was not generally appreciated that as much as $10,000 invested in a combination machine for billing, book keeping and recording consumption of water, gas or electricity by the "bill and stub" method, would cost the utility department no more than the pay for one mediocre clerk.

B. S. PARRISH said that he had learned by first hand experience the value of such machines for combined utility (water and light) offices. One girl could now turn out work in 7 days formerly requiring 30 days of her time and 10 days additional for checking computations for accuracy.

*R. J. Leveque, Superintendent Filtration, Fredericksburg, Va.*

*Maj. Richard Messer, Chief Engineer, Virginia State Department of Health*

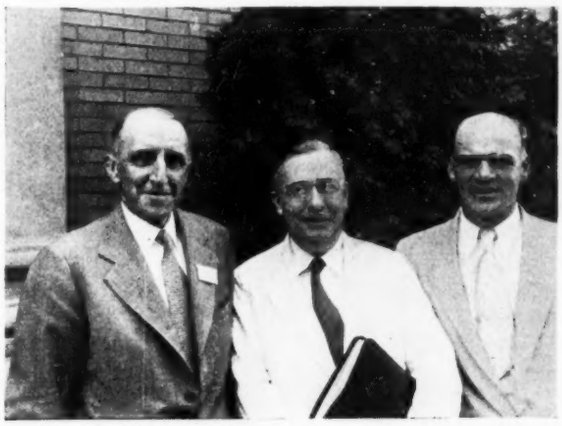
**"Need for Master Meters and Recording Instruments"**—R. J. LEVEQUE, Superintendent of Filtration, Fredericksburg, Va.

Mr. Leveque in pointing out the value of keeping adequate records and knowledge of operating conditions to avoid guess work and haphazard operation of plants, named what in his opinion were four essential instruments at filtration plants. These consisted of a master meter for adequate and most economical regulation of chemical applications; loss of head gages for proper filter maintenance and economy in wash water consumption; rate of filtration gages and wash water meter for the same purpose. His experience had indicated the falseness of economy when failing to provide and properly maintain these essential indicating and recording instruments.

ROY L. BISHOP, City Manager, Salem, Va., agreed with Mr. Leveque stating that the new plant at Salem had been equipped throughout with indicating and recording equipment for every operation with the exception of chlorine feed.

RICHARD MESSER, Chief Engineer, State Department of Health, reported that it was not uncommon to find pumps operating at low efficiencies in small places where no master metering equipment existed to indicate as much. In one instance a pump was, unknown to the superintendent, only delivering 60 per cent of its original capacity. Here a meter would have early disclosed this and paid for itself in current saved.

A question as to what type of meter was to be preferred was answered by D. R. TAYLOR, Superintendent, Water Works, Roanoke, Va., who from experience, preferred the Venturi type for continuous use but the crest or velocity type of meter had proved more satisfactory on supplies drawn from intermittently and thereby resulting in an idle instrument much of the time.



*The President of the A. W. W. A.—H. E. Jordan (in center). On his left is B. S. Parrish, Host and Chairman of the Section; on His Right Is "Beek" C. Little, Secretary of the A. W. W. A.*

## Trends in Water Purification Practice

**"Recent Trends in Water Purification Practice"**—HARRY E. JORDAN, Sanitary Engineer, Indianapolis Water Company, Indianapolis, Ind.

The Virginia Section was honored by the presence of Mr. Jordan in his capacity as president of the American Water Works Association and also as a speaker. He pointed out the greater amount of attention being properly paid to the matter of pre-conditioning water for filtration, i.e., less dependence on the filter bed to remove impurities and more dependence on improved coagulation, pre-chlorination, algae control and carbon treatment to serve as the shock troops, with the filters and post ammonia-chlorine treatment as the final lines of defense. He paid tribute to George W. Fuller as the pioneer in establishing the need for effective conditioning ahead of rapid filtration—really putting mechanical (rapid) filtration on its feet.

An outstanding recent development must, he said, be credited to M. C. Smith, of Richmond, and his coworkers who had established the value of mechanical conditioning and the development of the "flocculator" which rolled up the small particles into rapidly subsiding flocs and thereby reduced coagulant consumption. The new plant at Milwaukee, he said, was to be equipped with "flocculators" and unique two story coagulation basins in preference to single story deep basins. The Sacramento plant was being equipped with so-called "surface settlers" comprised of basins 8 ft. deep equipped with plates set at 45 degree slopes to accumulate sludge and drop it to the bottom.

In pre-conditioning waters pre-chlorination had estab-

*Col. Geo. H. Whitfield, Director of Utilities, Richmond, Va.*

*W. F. Day, Manager Henrico County, Richmond, Va.*

lished itself as a highly effective and important factor. One shortcoming, that of after putrification of sludge deposited from pre-chlorinated waters, had come to light and carbon treatment of the raw water had been required to prevent that condition. He considered continuous removal of sludge a highly desirable feature in future design. Mr. Jordan closed his talk with an emphatic statement that the lack of more effective regulation of operating personnel in water works generally, was to his mind deplorable. He felt it highly important that municipalities employ only those men as operators who can show qualifications meriting their appointment.

## Ferric Chloride Available in Anhydrous Form

**"Coagulants Used in Water Purification and Why"** —L. L. HEDGEPETH, Manager, Technical Service Department, Pennsylvania Salt Manufacturing Co., Philadelphia, Pa.

Mr. Hedgepeth, in an interesting manner, briefly discussed the chemistry of coagulation and the six coagulants now commercially available.

Filter alum, usually considered as sulphate of alumina, with 18 molecules of water of crystallization ($Al_2(SO_4)_3:18\ H_2O$) actually, he said, had but 14 molecules approximately which accounts for the fact that it contains 17 per cent or better water soluble ammonia ($Al_2O_3$). Sodium aluminate carrying 55 per cent $Al_2O_3$ content and considerable available alkali was now available at a price competitive with the cost of filter alum and caustic soda or soda ash in equivalent quantities purchased separately. Therefore, its use was justified and was on the increase in water softening for steam generation. Also it was especially meritorious as a secondary coagulant in soft colored water treatment in which primary coagulation is most economically effected at pH values of 5.5 or less.

Whereas, ferrous sulphate (copperas) used in conjunction with lime had limited application, when the copperas solution was oxidized with chlorine to produce "chlorinated-copperas" the range of application of this cheap coagulant was greatly broadened and was finding increased usage at worth while savings. The simplicity of "chlorinated-copperas" production was appealing when realizing that the ordinary dry feeder and a chlorinator discharging into the line carrying the dissolved copperas was all that was required to make chlorinated-copperas continuously.

Ferric chloride was generally supplied in barrels as lump crystal (60 per cent $FeCl_3$) or as a solution (42 per cent $FeCl_3$) in carboys or rubber lined tank cars—8,000 gallons and approximately 40,000 lbs. of absolute ferric chloride ($FeCl_3$) being the car capacity. The latest development had been the introduction of absolute (anhydrous) ferric chloride packed in air tight, light weight, steel drums holding 100 lbs. each. The material was practically chemically pure $FeCl_3$ and its chief advantage was its lack of inert material, including water, thus reducing transportation costs and storage problems. Mr. Hedgepeth pointed out the fact that, on an available coagulant basis, 1 pound of $FeCl_3$ is equivalent to 2.5 lbs. of filter alum and where procurable at a delivered price of $40.00 per ton will be a competitor with filter alum at $16.00 per ton. Added consideration must be given because of its advantages as a coagulant under a variety of conditions.

Another modern ferric coagulant was ferric sulphate $Fe_2(SO_4)_3$ now available in the anhydrous form. It had the advantage of being satisfactorily shipped in wooden barrels, stored and fed without difficulty—a dry feed machine when equipped with a properly designed solution vat and water temperature regulator would serve as a ferric sulphate feeder.

Mr. Hedgepeth emphasized the desirability of employing pre-chlorination when using any form of ferric coagulant, in order to preclude the possible reduction of a small quantity of the iron which would thereafter not precipitate prior to filtration. And, he pointed to the necessity of experimentation and comparison of plant costs when considering the several coagulants because without actual trials, conclusions of a sound nature could not be reached merely by assumptions or speculations based on previous conception.

L. H. ENSLOW, in discussion said that the introduction of anhydrous ferric chloride would materially benefit those municipalities now paying freight on water when purchasing solutions or lump ferric chloride. He also said that ferric chloride was such a corrosive coagulant that no attempt to use it should be made without rubber lined or equivalent equipment. If not properly equipped to use it one would find it disappointing because of attack on ordinary chemical feed lines. Rubber hose, hard rubber fittings and rubber lined equipment were thoroughly satisfactory—lead, brass and the like would not stand up. In comparing coagulants he endorsed Mr. Hedgepeth's statement—that the only way to learn their respective values was by actual trial in a comparative manner on a small scale first. Theoretically ferric-chloride was not as good a coagulant as the sulphate but actually that was not the case in practice.

**"Corrective Treatment for Cold Water Corrosion by Public Water Supplies"**—E. S. HOPKINS, Principal Sanitary Chemist, Montebello Filters, Baltimore, Md.

Mr. Hopkins in giving some pointers on cold water

*Getting Set for the Official Group Photograph*

corrosion control by addition of lime in an attempt to lay down protective coatings of calcium carbonate on the interior surface of mains, said that the calcium content of the water must be sufficiently high* to produce precipitation when bicarbonates had been converted to normal carbonates. Further, the lime application had to be continuous and sufficient to create the depositing condition at all times. With soft waters it might be necessary to add soluble salts to effect deposition of calcium carbonate. He recommended the use of burnt or hydrated lime as more economical than caustic soda or soda ash but warned that it should be added at the entrance to clear water wells if a milky water entering the mains was to be avoided. At Baltimore the lime (5.5 p.p.m. average) had cost $8,000 per year or 27 cents per m.g. for the treatment to maintain a pH value of 7.8 which was sufficient for their requirements. The original hardness of 51 p.p.m. was boosted 8 p.p.m. by the treatment. The alkalinity and pH value did not appear to diminish during passage through the distribution system. Against the cost of 27 to 28 cents per m.g. for lime applied, it was estimated that about $6.25 per m.g. represented the saving in maintenance and operation cost reduction on the distribution system. If soda ash had been used the treatment cost would have mounted to $2.00 or more per m.g. as compared to the 28 cent cost with lime. Comparing the added cost, if using soda ash, against the calculated increased soap consumption due to hardness increase of 8 p.p.m., they had concluded that one figure about balanced the other, i.e., about 8 cents per capita per year was the added cost for increased soap consumption. By switching to soda ash the extra cost would be an expense to the Water Department. They chose to stick to lime.

**"Effect of Meterization on Revenues and Consumption"**—E. H. RUEHL, Town Manager, Bluefield, Virginia.

Mr. Ruehl outlined the reasons for metering all water consumers. Although revenues would not be increased, there were other more important reasons such as increasing water pressures at distant and high points on the system; making existing mains serve where otherwise larger mains, increased pressures or pumping capacity would be necessary; conservation of water by curtailing waste. Particularly valuable were meters in drought periods when conservation was paramount. Above all it was good business to sell water on a basis of measured quantities and get paid for all water actually consumed. He favored monthly readings and billings even in small towns and stressed the necessity for efficient maintenance of the meters after installation.

**Experience indicates that a protective film of calcium carbonate can only be deposited if the bicarbonate of calcium hardness, to be converted by lime, is in excess of 35 p.p.m.—Ed.*

*E. H. Ruehl, Town Manager, Bluefield, Va.*

*W. S. Russell, Superintendent, Filtration, Salem, Va.*

*J. R. Abbitt, Superintendent Water and Sewerage, Sweet Briar, Va.*

*Martin Johnson, Consulting Engineer, Lynchburg, Va.*

Following Mr. Ruehl's paper, demonstration of flocculation tests with laboratory stirring device and other laboratory equipment used in making the simpler tests was ably staged by W. S. Russell of Salem, Va., and C. F. Bingham of Richmond, Va.

**"Operation of Small Sewage Treatment Plants"**—J. R. ABBITT, Superintendent, Buildings and Grounds, Sweet Briar, Va.

Mr. Abbitt, having charge of a small plant comprised of an Imhoff tank and sprinkling filter, recited his operating experiences. Routine operation required the services of one man for not more than 2 hours each day. Supervisory visits were made by himself once weekly as was a complete sewer inspection. The weekly tests included sludge depth measurements for which purpose a pitcher type pump with rubber suction hose was used. pH determinations were made on sludge and scum. Sludges between pH 7.4 and 7.6 had given best results and prevented scum build up in gas units. To maintain this range 50 lbs. of hydrated lime was required each day for the plant handling 150,000 g.p.d. domestic sewage. For odor control pre-chlorination was being used and post-chlorination was practiced continuously for filter effluent disinfection.

**"Sewage Treatment for Small Municipalities"**—MARTIN JOHNSON, Sanitary Engineer, Wiley and Wilson Engineers, Lynchburg, Va.

Mr. Johnson said that more frequently than not, small municipalities were located on minor and uncertain streams, thereby lacking in dependable dilution. As a result usually complete treatment of the sewage was necessary. He then described the several types of treatment and nature of plants adaptable to small places.

## Program of State Planning Commission

MAJOR C. J. CALROW, Consultant to the State Planning Board of Virginia, told of the plans under way by this recently established board. He said they were studying, among other things, waste disposal, water uses and water resources in order to attempt to plan for a program to cover public works construction in Virginia during a period of 10 to 20 years. The idea in mind was that of arranging for such construction, if possible, during periods when private construction was lagging.

Following a vote of appreciation to Major Richard Messer and his staff for their efforts in organizing and fostering the Virginia Water and Sewage Works Association, the meeting was adjourned.

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# NEW RATE CONTROLLER FOR FILTER PLANTS

By E. FRANK STOVER*

*University of Pennsylvania,*
*Philadelphia, Pa.*

THE accompanying curves show the results of tests made recently at the University of Pennsylvania on a new type of rate controller for rapid sand filters. The design of this unit is based on experimental work carried on by the writer since 1929, and was made with the following definite objectives in view:

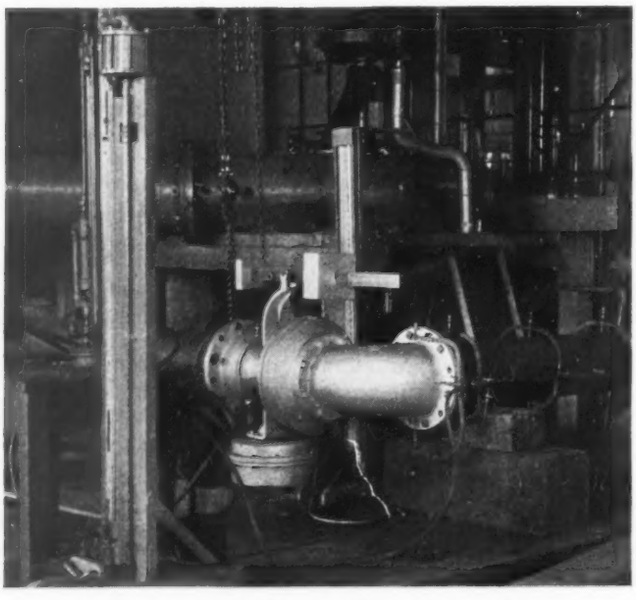
1. To produce a controller having the lowest obtainable head losses when wide open;
2. To attain a high degree of accuracy in control without the use of compensating or relay mechanisms;
3. To provide a valve mechanism which could be placed in a horizontal, vertical, or inclined pipe line and still be in perfect balance;
4. To cover the largest possible ratio of maximum to minimum rate with a given size of controller;
5. To keep size and weight down to a minimum;
6. To provide definite known relations between venturi head and counterweight position so that a rate scale could be calculated for any size unit, avoiding the usual calibration by measuring the drop in the filter.

Since some device that produced a head differential must form a part of any closed controller, it is desirable to utilize that device which accomplishes the best head recovery, namely, the venturi tube. The minimum loss will then be attained if no additional length and no obstructions to flow are added by the presence of the wide open valve. In this design the valve plates enter the section of the venturi tube through an annular gap in the wall of the recovery cone; and, when withdrawn, leave a completely unobstructed passage. Thus the loss is reduced to only that which is created by an unobstructed venturi tube.

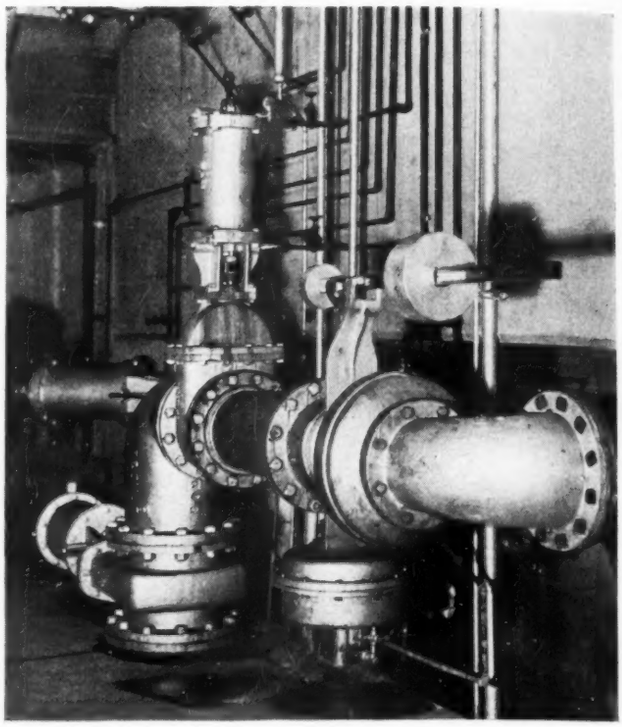
## Requirements for Accuracy

The requirements for attaining accuracy in a rate controller are these: Frictional resistance in the moving valve parts and in the pressure responsive device must be kept at a minimum; moving parts must be in static balance throughout the range of motion; unbalanced dynamic forces due to flowing water must be avoided; and, the pressure responsive device, to which the venturi head is applied, must have a constant effective area throughout the stroke.

*Instructor in Civil Engineering.



*The Controller (10 in. diam.) Under Test*
*Hydraulic Laboratories, University of Pennsylvania*



*The New Controller in Its Final State of Development Fabricated and Installed by Simplex Valve & Meter Co., for Proving Tests Under Routine Plant Operating Conditions. Note the Accompanying Chart Records*

In this controller two identical valve plates are mounted on stainless steel shafts which are parallel to, and on opposite sides of, the axis of the venturi tube. The shafts, carried on stainless steel balls and races, are so light in action that on a 10 inch controller a torque of less than one inch-ounce is required to move them through their range against a head of 60 feet and with shaft-packing tight. By their arrangement, the two identical valve plates are balanced against each other, thereby insuring static balance regardless of position in which the controller is placed. Since the motion of the valve plates is at right angles to the direction of flow, there is within the operating range no disturbing dynamic force in the direction of motion.

The upper limit of capacity of a controller is fixed by the allowable head loss with valve wide open. Since this unit suffers only the loss in the venturi tube, higher maximum rates for the different sizes can be maintained economically. The lower limit of capacity is fixed at that point where the change in venturi head necessary to move the valve involves a change in rate greater than the allowable percentage. Because of the light action of the moving parts in this design the controller

is capable of functioning at very low rates. Although the test curves show a ratio of maximum to minimum rates of about 6.25 to 1, a ratio of 8 to 1 is equally attainable.

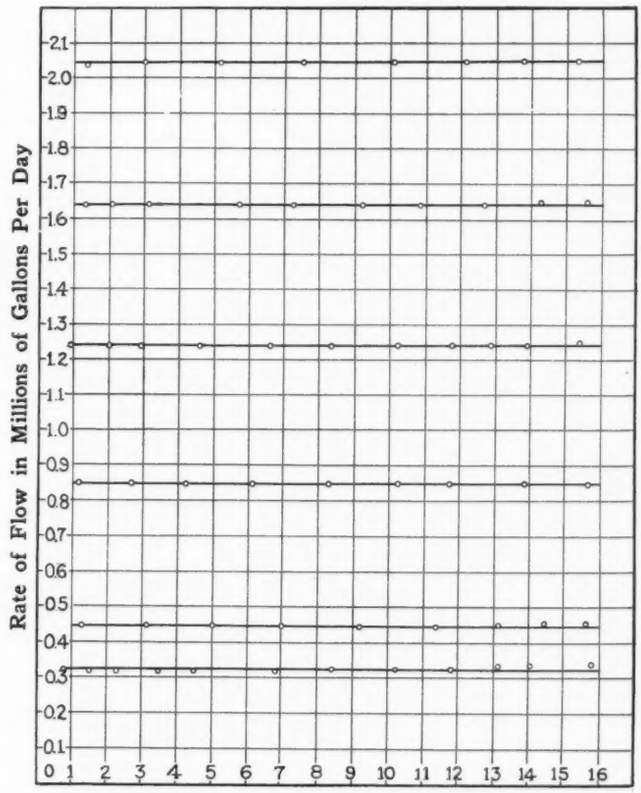
## Advantages from Departure in Valve Location

A decided departure from the usual design is in the location of the valve, which is at a section of high velocity. The choice of a high velocity section for the throttling point produces several advantages. The unit will continue to provide assured control until the valve is wide open, because even a small obstruction to the flow at a high velocity section will dissipate considerable head. That the maximum head may be dissipated at a wider valve opening, than would be possible at a low velocity section is likewise assured. By throttling at this section the valve casing and mechanism are placed within the length of the venturi tube, making an extremely compact unit, the laying length of the 10 inch size being only 35 inches. A further advantage is the small size and weight of valve parts for a given size of controller. This results in lighter loads on the mechanism, less friction, closer regulation, and a reduction of total weight. As may be observed in the illustrations the balancing load for the pressure responsive device is carried separately on a knife edge bearing, so that the valve bearings are subjected only to hydraulic loading.

Data obtained during tests show the position of the counterweight on the beam to vary as a constant power of the rate—thus, the rate scale may be graduated without a calibration test. The above relation also demonstrates the absence of unbalanced dynamic forces.

Reference to the accompanying laboratory test curves will show the degree of control attained by this unit. At the normal discharge for this size, the departure from the set rate is only plus or minus 0.35 of one per cent, over a range of "head dissipated" much greater than is encountered in the average filter plant. Although these curves do not show operation at values of head dissipated encountered in wash water and pressure control work, other tests have shown the same excellent performance under those conditions.

**Test of 10 Inch Type "S" Rate Controller for Accuracy of Control, University of Pennsylvania, Philadelphia, Pa., Hydraulic Laboratory**




*Results of Laboratory Tests of New Controller for Accuracy at Various Losses of Head (Stover)*

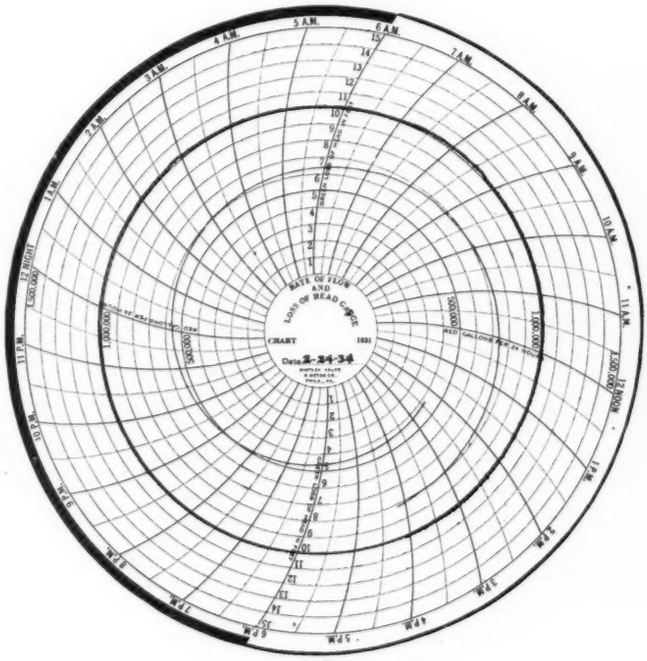



*Chart of Feb. 24, 1934*
*Showing Total Run of Filter to Be 49.5 hrs., and Washed at 8.2 ft. Loss of Head*

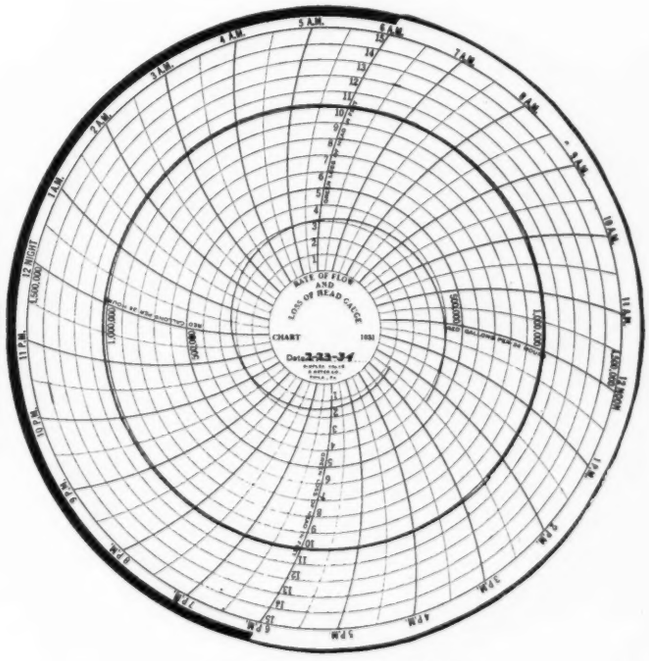



*Chart of Feb. 23, 1934*
*Initial Head Loss 1.2 ft. Increased to 4.2 ft. After 2.4 hrs. of Service*

*Note Constancy of Filter Rate Control at 1 M.G.D. Throughout Entire Run*

## Field Tests

In addition to the laboratory tests outlined, extensive service tests have also been conducted. The unit described was installed in a local filter plant in which the beds have a normal capacity of 1 M.G.D., with a maximum of 1.5 M.G.D.. A recording rate of flow and loss of head gauge was installed to keep a continuous record of performance. Also a special gauge with clock type chart was arranged to record continuously the position of the valve. This latter record is of particular importance in showing the free action of the valve in responding to changes in either direction, and in showing the complete absence of "hunting."

In this installation the controller was subjected to the regular routine of plant operation. Runs were also made at rates below and above the regular range. The highest rate attempted was approximately 200 per cent of the normal capacity of the bed, and even with this overload the control was excellent. Charts from the rate of flow and loss of head gauge are shown for a rate near the normal.

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## The Value of the New England Water Works Association

*E. Sherman Chase*

The New England Water Works Association holds its fifty-third annual convention in Boston this month—September. Organized in 1881, this Association has made a notable record of achievement in the half century and more of its existence. Although sectional in name, the Association has not been provincial in outlook or activities, as is attested by a large membership outside of the New England states.

From its beginning and throughout its history the Association has earnestly striven to advance the theory and practice of the water works profession. The reports of committees and the technical papers published in its official publication—The Journal of the *New England Water Works Association*—constitute a worthy and valuable recounting and recording of accomplishment. Among the particularly significant committee reports which have been published are those dealing with "Diversion Damages"; "Cross-Connections"; "Grading of Water Supplies"; "Yield of Catchment Areas"; "Uniform Statistics." Furthermore, many valuable papers have been published, which have unquestionably exerted a great influence upon waterworks practices and their advancement.

In the earlier years, alone; and, in later years in cooperation with the American Water Works Association and the American Standards Association, the New England Water Works Association has actively participated in the establishment of standard specifications for water works materials. This work has proved of great value to water works men throughout the country.

Inasmuch as the majority of members of the Association are located in the northeastern part of the United States, it has been feasible and fruitful to hold, throughout the year, several well-attended and more intimate meetings in Boston and other New England cities. Supplementing the large and less wieldy annual conventions, this practice has resulted in a relatively large proportion of members of the organization actively participating in its affairs. Under such conditions, the enthusiasm and loyalty of the membership is remarkably strong—a fact which augers well for the continued usefulness and influence of the Association for many ears in the future.

E. Sherman Chase

*President New England Water Works Association.*

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## Dearborn Awards Contract for Sludge Incinerator

Dearborn, Mich., authorities have let a contract for the first large incinerator designed to burn sewage sludge dewatered on vacuum filters.

The new incinerator is designed to reduce to a clean ash (without odor) 50 tons of a 65 per cent moisture filter-cake (17.5 tons of dry solids) from chemically precipitated sludge. Being the first installation for the duty intended, all incinerator manufacturers were invited to bid on this project, which is being financed by loan and grant from the P.W.A.

A part of the contract embodies rigid guarantees as to operating costs, freedom from odor nuisance and general performance, the failure to meet any of which obligates the contractor to remove his equipment and leave the property in the condition found by him at the time of starting the new construction—thus indicating for the first time reasonable expectation that sewage sludge containing non-combustible mineral salts, incident to chemical precipitation processes of sewage treatment, can be, without undue difficulties, incinerated in a practical manner. The expected composition of the sludge cake (on a dry basis) is 35 per cent combustible matter and 65 per cent ash, with a potential heat value of 10,000 B.T.U. per pound of combustibles.

The successful bidder was the Nichols Engineering and Research Corp. of New York City, who will install a newly developed incinerator patterned after the Nichols-Herreshoff multiple-hearth type of furnace, used for many years in the metallurgical, chemical and petroleum fields—notably for cintering and roasting ores.

Plans and specifications for the installation were prepared by E. C. Miller, Plant Supt., under direction of Mark B. Owen, Supt. of Public Works of Dearborn, and the project is expected to reach completion and operation begun early in 1935. The contract price was $56,000 for incinerator and all auxiliaries, installed and turned over to the city for operation.

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## Manual on Public Works Financing

A "Manual of Financial and Accounting Procedure for Public Bodies," published by the Federal Public Works Administration (P. W. A.), is available to municipal officials without charge. Designed primarily for the control of accounting on P. W. A. projects, the manual is equally as useful for ordinary public works projects. It was prepared by the Public Administration Service, a joint agency of eleven national governmental organizations, including the American Society Municipal Engineers. A copy may be had gratis by request to the P. W. A. at Washington, D. C.; the American Society of Municipal Engineers, 850 East 58th Street, Chicago, Ill., or the Editorial Offices of Water Works and Sewerage, 420 Lexington Ave., New York City.

# A DEEP OPEN-CUT SEWER OF UNIQUE CONSTRUCTION—A P. W. A. PROJECT

By EDWARD R. STAPLEY*

A 15-INCH trunk line sewer, involving a considerable proportion of deep cut, is just being completed in this city of 7,000 population. Unique features of this project are the construction of the entire sewer entirely in open cut, the use of a machine excavator and the laying of the whole line of double-strength vitrified clay pipe. The construction involved going to depths of 28 feet.

*E. R. Stapley*

City officials decided it would be more economical to build a shorter deep sewer through a section now partially built up than to build a circuitous shallower line, following natural drainage channels, through outlying territory. The new line as constructed provides relief for the already overtaxed sewer serving the Oklahoma A. & M. College campus, and this was a second consideration in deciding in favor of a deep sewer.

The project, entitled "The Construction of Trunk Line Sewer," is listed as Federal Emergency Project No. 1 for Stillwater and as P.W.A. Docket No. 2702. A Federal grant of $4,000 was made to the city. The contractor is the B. & M. Construction Corporation of Oklahoma City. The contract was let and the work has been carried out under the immediate supervision of Jack Briscoe, General Manager, and L. M. McGoodwin, City Engineer, of Stillwater.

## Estimates and Bids Very Close

Estimated quantities and engineer's estimate, together with the bids of the two contractors submitting bids on the project, are listed below:

| Item | Engineer's Preliminary Estimate | B. & M. Construction Corp. | Asplund Construction Company |
|---|---|---|---|
| 3,950 0 Lin. Ft. 15-inch No. 1, Double Strength Vit. Clay Pipe Sewer, complete in place..... | $1.15 | $1.20 | $1.20 |
| 25.0 Lin. Ft. 10-inch No. 1, Double Strength Vit. Clay Pipe Sewer, complete in place..... | $0.90 | $1.00 | $0.90 |
| 4,500 Cu. Yds. Unclassified Excavation, price includes backfilling, tamping, flushing, replacing sidewalks, paving, etc., and every item of construction connected with the ditch work..... | $ 1.50 | $ 1.60 | $ 1.70 |
| 10 Manholes, complete in place... | $90.00 | $75.00 | $75.00 |
| Estimated days for comp'etion (working) ..... | .. | 60 | 90 |
| Total Contract Price, based on estimated quantities ..... | $12,215.00 | $12,715.00 | $13,162.50 |

## Jointing Specifications

Specifications for the work followed in general those common to work of this character. Joints were to be constructed with dry jute packing and not less than one and one-half inches of asphaltic joint filler. This asphaltic filler was to consist of 30 penetration Texaco asphalt, or its equal, mixed in a proportion by weight of 40 per cent asphalt and 60 per cent of ground limestone, with 90 per cent of the latter passing a 200 mesh sieve. A variation of 10 per cent was allowable according to the weather. The joint mixture was to be poured at as low a temperature as possible and to be continually stirred so as not to separate before pouring. The heating kettle used was to be of sufficient size to hold material for several joints. Each joint was to be poured in one operation. It was specified that the contractor should exercise particular care to prevent overheating or burning the joint mixture.

Backfilling was to be accomplished by placing earth in thin layers and tamping up to a depth of 6 inches over the top of sewer. The remainder of the backfilling was to be in layers not to exceed 12 inches in depth, compacted with tampers weighing not less than 20 pounds per square foot of area. Water was to be used in compacting as directed by the engineer.

All excavated materials were to be the property of the city. The free haul limit was stated as 600 feet, with an allowance of one cent per cubic yard per 100 feet of overhaul. All excess supplies, materials, earth, stone, and other refuse had to be removed by the contractor, who had also to repair damages or injury to private or public property.

*Fig. 1.—General View of Trench and Equipment, Showing Two Lengths of Clay Pipe Being Lowered Into Trench by Dragline.*

The permissible infiltration of ground water was set at 25,000 gallons per mile per 24 hours.

On notification the City Engineer was at once required to have all mains or service pipes conflicting with the sewer line lowered or raised. All pipes below the sub-

*Associate Professor of Civil Engineering, Oklahoma A. & M. College, Stillwater, Okla.

grade cut or damaged by the contractor had to be immediately repaired by him, together with any damage done to lines above sub-grade due to his own carelessness or lack of proper precaution.

In computing quantities no deductions were made in length of sewer line for manholes or Y connections. The excavation was based on a stipulated trench width of 24 inches.

## Method of Payment

Payment of 90 per cent of cost of materials and labor in place would be made on approved estimates of the

*Fig. 2.—General View of Trench and Equipment, Showing Method of Bracing and Grade Boards.*

engineer. Extra work was to be at unit prices bid, or if no price bid, then at cost plus 20 per cent. Final estimate would be made upon completion and acceptance of work and the acceptance of maintenance bond by the Board of Commissioners of the city. A one-year maintenance bond on paving covering all openings in street

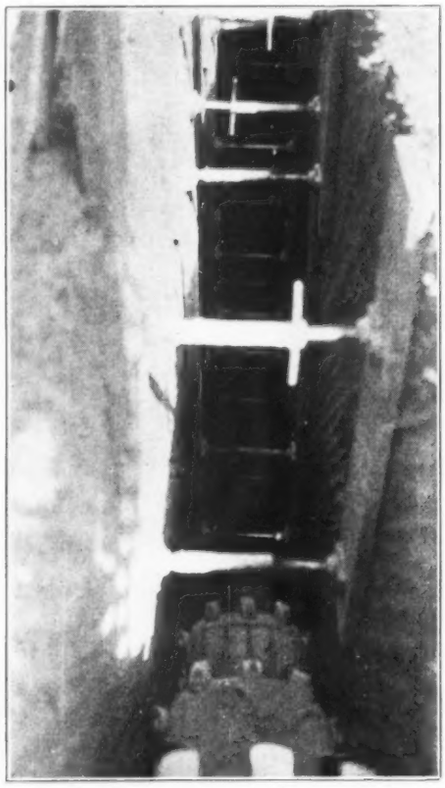


*Fig. 3.—View Looking Down in 28-Ft. Trench, Showing Character of Sidewalls, Method of Bracing, and Buckets on Excavator Boom.*

pavements or pavements damaged in any manner was required.

Since a large proportion of the proposed line was along paved streets, the line was constructed outside the curb line. Fortunately, it was possible to choose a side of the streets on which no sidewalks had as yet been built. Many entrance walks to houses had to be crossed, however, in addition to several paved streets and intersections.

## Deep Trenching With Machine

A very considerable part of the trench on College Avenue involved cuts from 20 to a maximum of 28 feet. This deep cut was all excavated with a Parsons No. 40 trenching machine. This machine was designed for a maximum depth of 18 feet and a maximum width of trench of 36 inches. The original length of boom was 24 feet. To this the contractor added 18 feet net length giving him a maximum digging depth of 28 feet. The trench as actually dug varied from 24 to 26 inches in width.

Other equipment used on the job consisted of a Sullivan No. 110 Air Compressor, a P. & H. 35 dragline-backfiller, and a smaller Parsons trenching machine used on the shallow trench along Washington street.

The stay-bracing used may be seen from the photographs. Due to the firm character of the soil and the dry weather prevailing during most of the work, this bracing was found sufficient even in the maximum depths. One pocket of sand and two heavy rains coupled with leaky sewer lines caused bad cave-ins at two street intersections and considerable loss of time and money to the contractor.

Ground water was encountered for short distances in two places, one of these being near a scenic pond on the college campus. Hard-pan, requiring the use of an air hammer, was encountered near the bottom of the trench in some cases. In one instance a thin layer of rock about 12 inches thick and about mid-depth in the trench was encountered. This necessitated excavating a shallow trench to the rock, breaking up same with the air hammer, and then completion of the excavation to full depth with the machine.

## Method of Placing Pipe

Two sections of the three-foot lengths of vitrified clay pipe were jointed together on the ground surface and lowered in the trench by the back filler. These lengths when suspended in a nearly vertical position, as shown in accompanying picture, could be lowered and placed in position without disturbing the trench bracing.

During a major portion of the work, the contractor's force consisted of 1 superintendent at $10.00 per day, a working foreman at 50 to 60 cents per hour, 3 operators at $1.00 per hour, 1 pipe layer at 75 cents per hour, 1 watchman at 40 cents per hour, and a variable number of laborers at 40 cents per hour.

On the early work in shallow depths on Washington street progress was at the rate of 50 to 70 feet of pipe per day. At the maximum depth of 28 feet this was reduced to 6 to 12 lineal feet per day. The two cave-ins previously mentioned resulted in zero progress for several days in each instance while the trench and excavating boom were being dug out by hand. As the job was started in January and not completed until June, it is apparent that the contractor lost money on the contract.

*NOTE: The author of this article has recently advised by letter that the project has been completed at a loss of $2,500 to the contractors. Failure to locate all rock in making up estimates for bidding purposes, and the heavy rains which caused the costly cave-ins of trench, referred to in the article, were responsible for the loss.—EDITOR.

Hetzer Heads Water Conference
WHEELING DAILY NEWS
WATER CONFERENCE OPENS HERE
Central States Section Of Water Association Opens Meeting Today
WATER RESEARCH DEVELOPMENT THEME OF LEWIS V. CARPENTER
PROMINENT MEN ATTEND SESSIONS
MURDOCK SAYS WATER REVENUE CAN EASE GENERAL TAX LOAD
HARRY JORDAN HITS 'NEW DEAL' POLICIES AT WATER CONVENTION
RECORD ATTENDANCE IS HERE FOR WATER WORKS ASSOCIATION
FOUR SPEAKERS ON PROGRAM FOR SESSIONS ON FRIDAY
F. P. LARMON TELLS OF SOME OF BRAZILIAN WATER PLANTS
YOUNG PRAISES STATE'S WORK
Water Men Elect B. J. Lechner
EDITOR OF 'WATER WORKS AND SEWERAGE' CITES DEVELOPMENT
GOOD WILL OF PUBLIC NEEDED
ASSOCIATION HEAD PRAISES WHEELING FILTRATION PLANT

*Water Works Convention Publicity—as it's done in West Virginia. These clippings are samples — there were more.*

# MEETING OF CENTRAL STATES SECTION A. W. W. A. AND WEST VIRGINIA WATER PURIFICATION CONFERENCE

THE Central States Section of the American Water Works Association held its 26th Annual Meeting jointly with the 9th Annual Meeting of the West Virginia Water Purification Conference at Wheeling, W. Va., August 22-24, 1934. A new record of attendance at the Central States Section meeting was established—there being a registration of 183 and more than 200 in attendance.

This joint meeting was an all round successful one in the matter of excellence of program, interest and entertainment—for which credit is due B. J. Lechner, in charge of the program; E. R. Eyler, in charge of entertainment; and, Chairman Lewis V. Carpenter, in charge of everything. The remarkable publicity given these meetings is attested by the number of major headlines and columns appearing during the three days of the meetings in the two local daily pages—the Wheeling News and the Wheeling Intelligencer. The quality and quantity of such publicity surpasses any which it has been the pleasure of this writer to have seen in connection with water-works meetings or conventions.

An unusual feature of the meetings was the afternoon session held in the loft of a barn in Oglebay Park—formerly the 750 acre farm estate of a local millionaire (Oglebay) and willed by him to the city. In the same building the annual (speechless) dinner was served, followed by entertainment and dancing.

The City of Wheeling was host to members and guests at an unusually enjoyable luncheon, served on the operating floor of Wheeling's spick and span filter plant—now 10 years old, but recently CWA renovated.

## New Officers

The following officers were announced for 1934-35:
Central States Section A.W.W.A.—

Chairman—B. J. Lechner, Secy.-Treas., Water Department, Erie, Pa.

Vice-Chairman—W. W. Morehouse, Supt. Water Works, Dayton, O.

Secy.-Treas.—H. L. Nelson, U. S. Pipe and Foundry Co., Pittsburgh, Pa.

Trustees—W. R. La Due (Akron), H. L. Nelson (Pittsburgh), Geo. Keefer (Pittsburgh).

Professor L. V. Carpenter (Morgantown) was chosen as the Central States Section representative on the A.W.W.A. Board of Directors.

West Virginia Water Purification Conference:—

President—Mentor Hetzer, Supt., Water Co., Moundsville, W. Va.

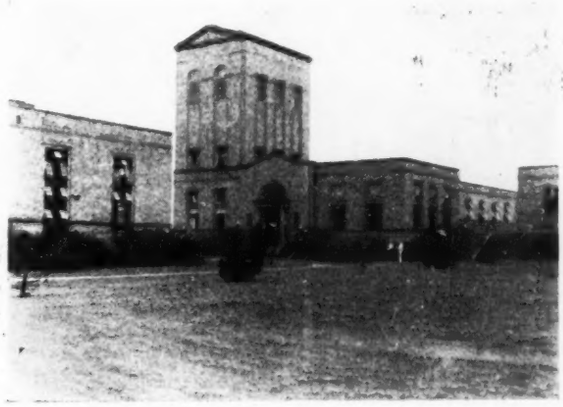
Vice-Pres.—W. E. Holy, Supt., Water Works, Madison, W. Va.

Secy.-Treas.—J. B. Harrington, State Department Health, Charleston, W. Va.

Trusees—A. R. Todd (Wheeling), Jas. Buchanan (Fairmont), Geo. Huber (Parkersburg).

## President Jordan Addresses the Section

H. E. Jordan, President of the A.W.W.A., in addressing the section on "The Value of American Water Works Association" said that he personally felt that it



*Wheeling's Filter Plant and Pumping Station.*

*Lewis V. Carpenter, Retiring Chairman Central States Section; Elected A.W.W.A. Director.*

*B. J. Lechner, Secretary-Treasurer Water Department, Erie, Pa. The new Chairman.*

was to be regretted that municipal water works authorities had rejected the opportunity to set up a Water Supply Code for the good of the industry and water works men generally. The next best opportunity of bettering conditions and increasing unity amongst water works men was through the workings of the American Water Works Association and its sectional meetings. He reviewed some of the most important activities of the Association and said that the committee developing "Standard Specification for Cast Iron Pipe and Fittings" had about completed its work. The Committee on Water Works Practice was about ready to distribute its report on "Pumping" and a second report on the subject of "Distribution" was also nearing completion. "Methods of Analysis of Water Works Chemicals" and "Specifications for Chemicals," for use in water treatment practice, were now in the process of development by a committee headed by M. M. Braidech of Cleveland. Mr. Jordan also recounted the valuable work of Past-President Malcolm Pirnie in behalf of water works men at Washington, particularly his close attention to developments in the R.F.C., P.W.A., and C.W.A., in respect to water supply betterments.

Mr. Jordan called attention to a new activity of the present Administration which had established a Water Resources Committee to study the water supply of the nation. In a program of water supply control there was a great opportunity to create valuable and lasting public works projects, provided the committee's program was soundly conceived and executed to the best interests of all.

Lack of respect, and appreciation, on the part of city officials, for the efficient technical services of water supply men had been deplorable. Dismissals of proficient men, explained on grounds of economy, could not be justified and was usually the result of political changes. Too frequently the water works man was being considered an incident in one municipality's operations, whereas he should consider himself as part of a nation-wide group. Unity of thought and purpose was much needed amongst water supply men and on this score the American Water Works Association needed more members and greater support to accomplish such ends.

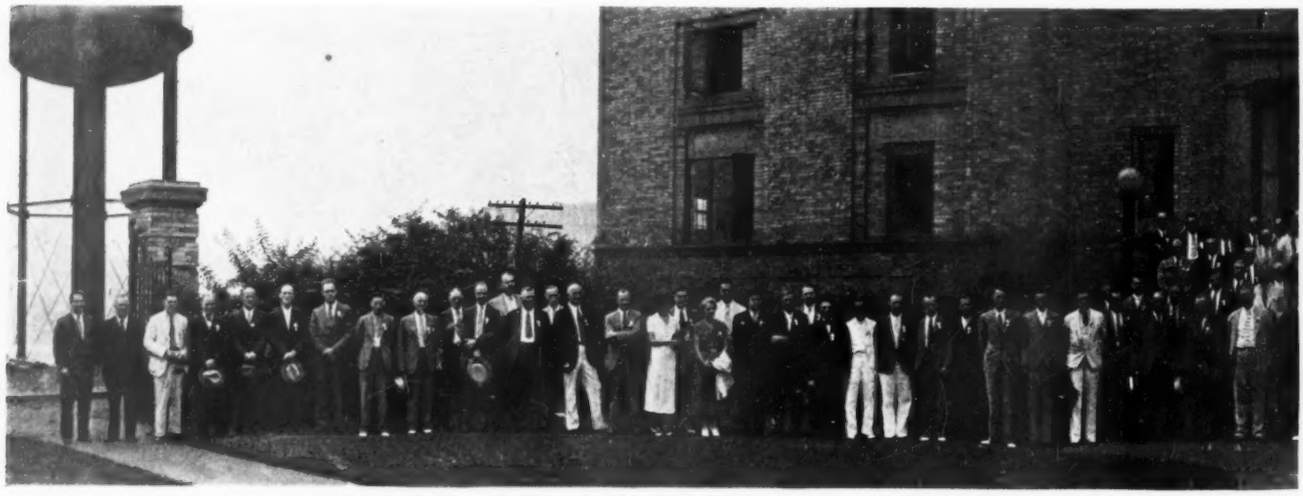
*T. P. Young, Manager Chester Water Co., Chester, W. Va., Retiring President of the W. Va. Conference.*

*Mentor Hetzer, Superintendent Water Co., Moundsville, W. Va. Elected President of the W. Va. Conference.*

## West Virginia Water Purification Conference

(Chairman T. L. Young, Presiding)

The first day of the joint meeting was given over to the meeeting of the West Virginia Water Purification Conference which was opened by a short address by the Chairman, T. L. Young, Manager of the Chester (W. Va.) Water Company. In this he paid high tribute to the work of the Sanitary Engineering Division of the Department of Health, and Professor Carpenter's



*Joint Meeting of the Central States Section of the American Water Works Association and the West Virginia Water Purification Conference at Wheeling, W. Va.—Photograph taken following the Luncheon Served at the Wheeling Filtration Plant.*

Department at the University of West Virginia, in raising the standards of water supply practices and the training of water works operators.

Thereafter, Professor Carpenter lectured on the "Laboratory Control of Water Treatment" in which methods of evaluating floc formation, calculations of chemical dosages and making up operating reports were described. Employing class-room technic, operators attending were called upon to give answers to questions and explain calculations.

Professor Carpenter said that acid streams, caused by mine drainage, had created a problem for the laboratory. The presence of iron and aluminum interfered seriously with titrations for acidity when using methyl orange and in consequence methyl red was for this purpose the preferred indicator. To convert titrated acidity with methyl red, to methyl orange acidity, it was necessary to multiply the burette reading by an imperical factor of 0.54. Waters carrying 30 p.p.m. iron with an acidity of 195 p.p.m. were not uncommon. The problem of determining the correct lime dosage to neutralize the acidity and precipitate iron, aluminum and manganese was an important one. To calculate this "lime demand" the jar test in which lime is added to produce a pH value of 8.5± (decided pink to phenolpthalein) was useful but time consuming. A method suggested as being quicker, involved the acidity titration with methyl red and converting by the factor 0.54 to methyl orange acidity. Each p.p.m. of methyl orange acidity would require 0.562 p.p.m. calcium oxide (Ca O) --approximately 5 lbs. of burned lime per m.g.

*W. R. La Due, Superintendent Water Department, Akron, O. Trustee of the Central States Section.*

*W. W. Moorehouse, Superintendent Water and Sewerage, Dayton, O., Trustee of the C. S. Section.*

*Perkins Boynton, Superintendent Purification, Clarksburg, W. Va.*

*J. B. Harrington, State Department of Health. Secretary of the W. Va. Conference.*

## The West Virginia Operators Licensing Law

**"The Licensing Law—Its Effect on Operators"**—was discussed by PERKINS BOYNTON, Superintendent of Purification, Clarksburg, W. Va., from the operator's point of view. He spoke of the early fears of this new law by operators, whereas, it was now considered by them as of great value in increasing efficiency of plant operation; knowledge of operators; greater security of position. There had always been a favorable relationship between the personnel of the State Department of Health and operators, and none felt that there had been any partial or unfair treatment. The school which all operators had been required to attend at the University of West Virginia, had been of inestimable value in preparing for the examinations. Out of this had grown schools at local plants and marked operation improvements.

J. B. HARRINGTON, Engineer, State Department of Health, said that licensing had resulted in increased knowledge of operators to the point that calls on his department for help had been materially reduced. Further, before the licensing law went into effect some unexperienced local man would be appointed plant oper-

*Joint Meeting of the Central States Section of the American Water Works Association and the West Virginia Water Purification Conference at Wheeling, W. Va.—Photograph taken following the Luncheon Served at the Wheeling Filtration Plant.*

*Jas. K. Buchanan, Manager Monongahela West Penn Water Co., Fairmont, W. Va.*

*H. Loyd Nelson, U. S. Pipe & Foundry Co., Pittsburgh, Secretary of the Association.*

ator in which case their time was required to train him. Now, municipalities were, where necessary, going outside of the city or town for qualified (licensed) men. Further, it was being required that every shift operator of purification plants have some grade of license—rather than consider licensing of the superintendent or chief operator as being sufficient. It was pointed out that about 50 per cent of the water works in the state were private owned and the licensing law had been well received by these.

Professor Carpenter said that the new law kept operators on their toes but he believed that, for the best effect and added stimulation licenses should be subject to renewal every third year. C. J. Bruce, Superintendent Water Works, Cumberland, Md., spoke in favor of licensing acts; said that Maryland was planning to have one. J. A. Keils, Superintendent Water Works, Mt. Clemens, Mich., told of the operation and value of the licensing law in Michigan.

## Public Relations and Trends in Utility Financing

**"Public Relations"** was to have been discussed by W. R. Voorhis, Chief Counsel, American Water and Electric Company. Being unable to attend at the last minute, Professor Carpenter announced that this topic would be dealt with by a "pinch-hitter" that he had prevailed upon to serve at the last minute.

Jas. K. Buchanan, Manager, Monongahela West Penn Water Company, Fairmont, W. Va., proved to be a "pinch hitter" with a real wallop. His impromptu talk on "Public Relations," as he saw them, was filled with logic, sincerity and spirit of a man who practices his preachings.

Mr. Buchanan, in tracing the history of utility developments, pointed out that in the first stages engineering was the foundation stone, then later came the necessity of salesmanship of service to the public. At this stage the matter of public relations had the spotlight and public relations men were of the highest importance in the utility field because of the, necessarily, monopolistic character of the business. The key to satisfactory public relations, he said, was human relations and that meant a more personalized service—a closer contact between consumer and utility officials who could forget the old axiom that "the company was always right," and, overlook the book of rules and regulations in favor of common sense and the Golden Rule. The greatest corrective to unsatisfactory relations between the public and a utility, to his mind, was to be found in drilling employees in the matter of company policies rather than rules and regulations; modification of "standardized practices," in favor of greater personal contact between the manager and consumer, rather than leaving decisions to employees with inferiority complexes brought on by adhering too constantly to rules and regulations. Personal attention, he said, was secretly craved by everyone and the surest way to friendly relations was to give it to the customer with a grievance —the higher the official giving it, the greater the appreciation. "Big Business" had suffered from too much organization and standardization and the same tendency had been felt in the utility field.

J. H. Murdoch, Manager, Uniontown Water Company, Washington, Pa., in discussion, said that of the 35 companies in the chain with which he was connected there were but 3 where public relations were admittedly unsatisfactory. It was more than a coincidence that in the latter the managers in each instance were old-line men who were imbued with the fact that "the company was always right." Charges for minor services and small items created ill feeling toward a public utility and the loss more than offset the temporary monetary gain. It had been their policy in recent times to do away with standardized rules covering the making of such charges—and, with very gratifying results.

H. E. Jordan, Indianapolis (Ind.) Water Company, complimented Mr. Buchanan on what, from his own experience, seemed to be a very correct diagnosis and solution of the situation in general existence. At Indianapolis they had for some time been drilling company employees in the use of more common sense in a better understanding of company policies and, thereby, less dependence on the book of rules.

**"Trends in Public Utility Rates and Financing"**—John H. Murdoch, Uniontown Water Company, Washington, Pa.

In his introductory remarks, Mr. Murdoch, who is Chairman of the Financing and Accounting Division of the A.W.W.A., said that his recommendations might possibly be contradictory to those advocated by that

*Curb Lecture on Locating Mains, by S. H. Davis, Supt., Benwood-McMechen Water Co.*

*The Barn in Ogelbay Park Where One Session and the Dance was Held.*

*Prof. Carpenter Trying Out the Wireless Pipe Locator.*

*The chairman (left) snapped in a group with Earl Johnson of Wallace & Tiernan Co., and Hayes Kuhns of the Leadite Co.*

division of the Association, which was yet young. He said that he felt, however, that some forward steps should be taken by it in the matter of rate making and financing by water utilities, both publicly and privately owned. In the past, privately owned water companies, through holding companies, had made the serious error of pyramiding in financing; had suffered in consequence. There had, however, been no failures of operating companies and the use of funds from bond sales for other purposes than strengthening utility properties was now illegal and thereby worked for sounder financing. Court rulings in respect to municipally owned water supply had been to the effect that a public utility operation was in a sense a private business, subject to state regulation but not confiscation. He felt that the trend should be in the direction of equalization and public utiities should be taxed on the same basis as privately owned utilities. Recent decisions of the Federal Supreme Court had indicated a decided trend in that direction.

Touching on the policy of municipalities in diverting water works income to uses other than financing the water utility, he cited the Lancaster, Pa., case wherein a taxpayer's suit was brought to force the diversion of utility profits to the general funds and thereby reduce taxation. The courts had decided that such practice is legal and, thereby, approved. This constituted a decided reversal of prior concepts that consumers should not be penalized for the benefit of property owners that they might pay less tax for general purposes.

Mr. Murdoch recommended that the A.W.W.A. should advocate the keeping of adequate financial records by all publicly operated utilities and that these records be given publicity and put out in a form subject to a clear understanding. Further, that all future rate making by publicly owned plants be sufficient to cover the cost of operation and carrying charges and eliminate the practice (political expedient) of paying for utility operating costs out of the general tax fund.

## Wolman Heard on the Radio

In the afternoon session, Abel Wolman was heard in an address over the Columbia System in a nation wide broadcast. His talk, designed for the layman, placed before him a picture of the importance and necessity of adequate water supply, its meaning to a community in the matter of health, sanitation and property protection. He picturized the cheapness of this indispensable product and the scant appreciation of it by the general public until a failure of service or foul tastes appeared. At the close of his talk a telegram of appreciation was sent to Mr. Wolman by the Conference.

Professor H. W. Hodge, Chemical Engineering Department, University of West Virginia, Morgantown, W. Va., presented a paper on the mineral qualities of Morgantown's water supply. The marked difference in hardness of the impounded supply (54 p.p.m.) and the acid Monongahela River (used for 4 months each year and mounting to 400 p.p.m. in hardness) was very noticeable and objectionable to consumers. Because of the presence of acid mine drainage the hardness was almost wholly permanent (sulphate) hardness. Since coke plant waste had practically been eliminated from the river, tastes were infrequent. Investigation of sources other than the river, including deep wells, had shown these to be insufficient and therefore the need of a softening plant was indicated.

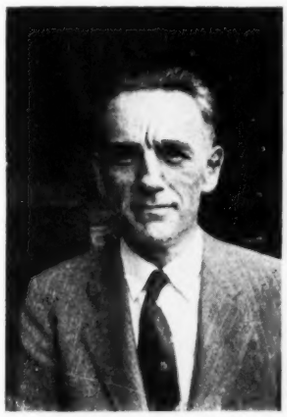
*J. R. Brown and Chas. Gregg, representing National Water Main Cleaning Co., and Dresser Mfg. Co., respectively.*

*George Keefer (right) of Rensselaer Valve Co., who has attended 29 meetings of the C. S. Section, is a member of the Board. (Left) M. G. Mansfield of Morris Knowles, Engineers.*

## The Question Box

From the "Question Box Hour" the following highlights are taken.

The control of lime addition, for corrosion control, by making the marble solubility test was not always sufficient. Although, a satisfactory control test on semi-hard waters (treated to a pH or 7.8 to 8.5) no less than 9.2 pH was required to arrest cold water corrosion by



*C. S. Trowbridge, Chief Chemist, Am. W. Wks. & Elec. Co., N. Y. City.*

*Douglas Feben, Department Water Supply, Detroit, Mich.*

waters with less than 35 or 40 p.p.m. calcium bicarbonate hardness, regardless of its total hardness. With softer waters a protective film could not be laid down on the pipe interior and the high pH value was essential—possibly a matter of control of biological effects, responsible for corrosion, as well as the chemical effects.

Stripping of reservoir sites is no longer practiced as a rule, being considered unjustified except in special cases, wherein the water level is to rise and fall frequently, wherein marginal stripping becomes justified . . . In distilling waters treated with ammonia and chlorine the first distillate may be rich in chloramines The use of distilled water in B.O.D. determinations has, in consequence, disinfected the incubation bottle contents and vitiated results...In odor and taste correction "good housekeeping," in the matter of control of algae and cleanliness of basins, filters and clear wells, counts for much (possibly more) than the use of some of the corrective treatments available. That is, accumulations of putrefying organic matter had best be avoided than counteracted with chemicals later. Musty tastes and odors, difficult of elimination, were the result of poor housekeeping in filter plant operation...The use of silver deposited on porous materials forming a contact bed had been used abroad as a water sterilization unit and had been studied in America also. The question of practicability and costs remained to be demonstrated . . . A water containing 2500 p.p.m. Sodium Sulphate and 400

*A. R. Todd, Superintendent Filtration, Wheeling, W. Va.*

*Ellis S. Tisdale, Chief Engineer, State Department of Health, Charleston, W. Va.*

p.p.m. Magnesium Sulphate is actually being used as a public supply.

## Papers Presented Before the Central States Section

**"Improvements at the Wheeling Filtration Plants"** —A. R. Todd, Superintendent of Filtration, Wheeling, W. Va.

Mr. Todd, in a highly complimented presentation, related the troubles experienced in treatment of the iron and manganese bearing, corrosive and taste producing Ohio River water at the 10 year old Wheeling Filtration Plant. He revealed the means employed in overcoming taste and corrosion troubles. In cleaning up and revamping the plant, C.W.A. funds had been made available for making several beneficial improvements and it had become apparent that a clean plant and good-housekeeping was the key-stone in producing a more palatable water. Experiencing considerable difficulty from redwater in the far reaches of the distribution system (iron increase from 0.2 p.p.m. at the plant to 2 p.p.m. and CO 2 to 6 p.p.m. 5 miles distant) lime treatment of effluent to a pH of 8.3 was tried with partial success only. Increasing the pH to 9.4 almost wholly corrected the trouble except on dead ends. The adoption of the ammonia-chloride treatment ($1.NH_3$ to 4Cl) had produced the additional improvement sought for on dead ends.

In cleaning up the plant, the old dirty (heavily coated) sand was found beyond recovery and was therefore replaced by new sand. Coagulation was changed to employ sulphate of iron and lime, and soda ash in addition during acid river stages. The new sand and improved coagulation reduced the color of effluent from 20 p.p.m. to 2 p.p.m., indicative of the practically complete removal of iron and manganese and all turbidity by the change in treatment and new sand beds.

With the clean sand, prechlorination (14 lbs. per m.g.) could be used without taste production and the filters maintained in a sterile condition. Because of occasional phenol spills in the Ohio, pre-ammoniation was being employed also. Activated carbon applied to the raw water had been effectively used to check putrefaction of sludge and improve taste elimination without removing the pre-chlorine dosage applied. Post chlorination (2 lbs. per m.g.) was practiced as a final safeguard although the conditions throughout the plant were practically sterile.

In the conclusions cited by Mr. Todd, great emphasis was placed on cleaning up basins and filter beds; continuous prechlorination to maintain such cleanliness and sterile conditions; the use of ammonia chlorine treatment for prevention of tastes and dead end troubles; maintaining the pH value required to remove iron and manganese and prevent main corrosion—(pH 9.4 for Wheeling's conditions) more effective filter washing by increased rates on otherwise small dosages of powdered carbon to maintain inert sludge and to enhance taste elimination; above all, effective sanitation, cleanliness and good-housekeeping.

John F. Laboon, Consulting Engineer, Pittsburgh, Pa., designer of the Wheeling plant—spoke highly of the improvements brought about in plant conditions and operation through the repeated efforts of Mr. Schull, General Superintendent of Water Works, and Mr. Todd to get the required appropriation. The value of the use of C.W.A. and F.E.R.A. funds for the purpose had been amply demonstrated. Although plant design had been considerably improved since the Wheeling plant was built 10 years ago, the fact remained that efficient operators were as essential as proficient designers. He said the practicability of feeding pebble or ground quick lime through dry feed machines, first demonstrated at the Wheeling plant, had proved completely satisfactory. Manganese passing the filters, because of deficient lime application to the raw water, had coated clear well and mains and had been shown to be responsible for the dissipation of residual chlorine in the finished water.

S. H. Davis, Superintendent, Benwood-McMechen Water Company, said that his troubles had cleared up since the introduction of improvements cited by Mr. Todd, especially noticeable had been the better conditions on dead ends. His company's system, 5 miles from the Wheeling plant, was supplied treated water at wholesale rates for retailing through a distribution system owned by them. Complaints on wash days had particularly cleared up and his existence was more comfortable.

E. S. Tisdale, Chief Engineer, State Department of Health, in adding his compliments on the results attained by Messrs. Schull and Todd, pointed out the fact that the plant had suffered because of diversion of water works income to other city funds—an example of unfair practice if not actually a dangerous one when plant improvements were so evidently needed. He cited the effective reduction of pollution of the Ohio and its tributaries by phenolic and other taste producing wastes resulting from the cooperative work of the Health Departments of Ohio, West Virginia and Pennsylvania (Ohio River Board) during the past several years.

L. H. Enslow rose to add his compliments to Mr.

*S. H. Davis, Supt. Water Company, McMechen, W. Va.*

*J. A. Angove, Commissioner of Water, Oil City, Pa.*

Todd for his meaty papers and the results procured. He said that, ordinarily, ammoniation should be held for the filter effluent because of greater economy as well as increased efficacy of prechlorination. At Wheeling the possibility of phenol spills in the river had justified Mr. Todd's adhering to pre-ammoniation—whereas a high prechlorine application with carbon applied ahead of the filters would be a more universal choice under a greater variety of conditions.

E. D. TRAX of McKeesport, Pa., agreed with Mr. Todd that a pH value of 9.4 was frequently required to correct corrosion. In this case, if the adjustment was applied to the raw water, as at Wheeling, manganese would not pass the filters.

## With Apologies

It is regretted that lack of space in this issue prevents completion of the digest of the following additional papers presented before the Central States Section:

"Tastes and Odors in Water"—by Martin E. Flentje.

"Effect of Road Oils and Tars on Water Supplies"—by L. V. Carpenter, E. W. Klinger, Geo. W. Pyle.

"Nitrifying Bacteria in Water"—by Douglas Feben.

"Conditions Under Which a Flow of Electric Current Through Mains Caused Corrosion"—by Charles E. Trowbridge.

"Scope and Accomplishments of the Mine Sealing Program on the Ohio River Watershed"—by E. S. Tisdale, E. W. Lyon and J. W. Chapman.

"Highlights on Recent Developments in Water Supply Practices"—by L. H. Enslow.

*A NOVEL GRAVITY SUPPLY MAIN*

*This time it's dry cement and not water which is conveyed through this 9-in. steel pipe line 3,500 ft. long, to the lower mixing plant at Boulder Canyon Dam. It was important to secure smooth welded joints of great strength to stand the 1,000-ft. drop at one point. Photo—Courtesy of the Lindeweld Division of the Linde Air Products Co., New York City.*

## Association Meetings Scheduled

Sept. 17-19—**Rocky Mountain Section, A. W. W. A.** Santa Fe, N. Mex. Secretary, B. V. Howe, State Board of Health, Denver, Colo.

**Sept. 18-21—New England Water Works Association. Annual Convention. Hotel Statler, Boston, Mass. Secretary, Frank J. Gifford, Trement Temple, Boston, Mass.**

Sept. 19-21—**Michigan Conference on Water Purification.** State College, East Lansing, Mich. Secretary-Treasurer, John Hepler, State Department of Health, Lansing, Mich. (Short school for water operators to be held 17th-19th at same location.)

Sept. 20-21—**Minnesota Section, A. W. W. A.** Duluth, Minn. Secretary-Treasurer, R. M. Finch, 414 Flour Exchange Bldg., Minneapolis, Minn.

Sept. 24-26—**Wisconsin Section, A. W. W. A.** Wausau, Wis. Secretary, L. A. Smith, Supt., Water Department, City Hall, Madison, Wis.

Sept. 24-27—**American Society Municipal Engineers.** Rochester, N. Y. Secretary, C. W. Sammelman, 4359 Lindell Blvd., St. Louis, Mo.

Sept. 26-28—**International Association Public Works Officials.** Hotel Sagamore, Rochester, N. Y. Secretary, A. M. Anderson, 100 N. La Salle St., Chicago, Ill.

Oct. 2-3—**Ohio Conference on Water Purification.** Deshler Hotel, Columbus, Ohio. Secretary, Frank S. Taylor, Superintendent Water Purification, Defiance, Ohio.

Oct. 4-5—**Ohio Conference on Sewage Treatment.** Deshler Hotel, Columbus, Ohio. Secretary, W. B. Lockhart, Superintendent Sewage Treatment, Fostoria, Ohio.

Oct. 5-6—**New York State Sewage Works Association.** Oneonta, N. Y. Secretary-Treasurer, A. S. Bedell, State Department Health, Albany, N. Y.

Oct. 11-12—**New York Section, A. W. W. A.** Hotel Statler, Buffalo, N. Y. Secretary-Treasurer, R. K. Blanchard, 50 W. 50th St., New York City.

Oct. 15—**New England Sewage Works Association.** Providence, R. I. Secretary, F. W. Gilcreas, State Department of Health, Albany, N. Y.

Oct. 15-17—**International City Managers Association.** St. Louis, Mo. Executive Director, C. E. Ridley, 850 E. 58th St., Chicago, Ill.

**Oct. 15-18—Southwest Water Works Association. Hotel Hilton, Waco, Texas. Secretary, Lewis A. Quigley, Superintendent Water Department, Fort Worth, Texas.**

Oct. 24-27—**California Section, A. W. W. A.** Long Beach, Calif. Secretary, J. E. Phillips, Department Water Supply, 207 Broadway, Los Angeles, Calif.

Oct. 29-31—**Pennsylvania Water Works Association.** Haddon Hall, Atlantic City, N. Y. Secretary, F. H. Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Nov.—**North Carolina Section, A. W. W. A.,** and **North Carolina Sewage Works Association.** Hotel Virginia Dare, Elizabeth City, N. C. Secretary-Treasurer, H. G. Baity, Dean of Engineering, University of North Carolina, Chapel Hill, N. C. (Exact date not decided.)

Nov. 8-10—**Missouri Valley Section, A. W. W. A.** Hotel Fontenelle, Omaha, Neb. Secretary, Prof. E. L. Waterman, University of Iowa, Iowa City, Iowa.

## New York State to Have Its First Municipal Softening Plant

The first municipally-owned softening plant in New York State is to be shortly built.

The taxpayers of Delmar, Albany Co., N. Y., have voted to construct a new 12 M.G. reservoir, a new pipe line and a water softening plant. The project will cost $93,000 and is to be financed by loan and grant from the P.W.A.

The supply is taken from wells and has a hardness varying between 125 and 200 parts per million. Softening will be accomplished by employing the zeolite process possibly of the automatic or self-operating types.

# IMPROVING SEWAGE PLANT OPERATION AT SPRINGFIELD, MISSOURI

By RALPH E. FUHRMAN

*Superintendent of Sewage Treatment Plants, Springfield, Mo.*

*Ralph E. Fuhrman*

THE "high and dry" location of Springfield creates for this city one of the largest sewage treatment problems in Missouri. Within its corporate limits, the drainage areas of the Osage River of central Missouri and the White River of southern Missouri joins, and as a result the water courses draining the city are little more than intermittent streams. For this reason, it is necessary to treat the sewage of each watershed separately and completely to avoid gross pollution of these small streams. To obtain the necessary degree of treatment, the existing facilities must be operated at their highest efficiency and the processes must becarefully controlled. During the course of growth and development of the sewer system, treatment plants of various types have been built. Now there are four: One separate sludge digestion plant with trickling filters and gas collection; two Imhoff-trickling filter plants with final settling, and one septic tank. The operation of each of these plants except the septic plant is laboratory-controlled, and a very decided improvement in operation has resulted since the laboratory was established.

## Importance of Laboratory Control

The routine laboratory tests include 5-day B O D's and suspended solids determinations on the raw sewage, partially treated sewage, and the plant effluents. Dissolved oxygen and methylene blue stability tests also are made on the plant effluents. Dissolved oxygen and 5-day B O D's are run on the receiving streams at several points to determine the rate of self-purification. Such data give direct information on the accomplishment of each unit of each plant in addition to the effect of the effluents on the steams; and, give a real basis for planning improvements in operation and construction. The laboratory is very useful in controlling sludge drawing from the Imhoff tanks. Our digestion chambers are very crowded, but careful interpretation of sludge analysis makes it possible to draw the proper amount of sludge, and in this way keep the digesting sludge from interfering with the settling process in the tanks and also prevent acid digestion with the resulting troubles and nuisances of foaming. Sludge analyses are helpful in the operation of our separate sludge digestor by giving data which reflect the variation in digestion rate due to temperature changes and time of digestion.

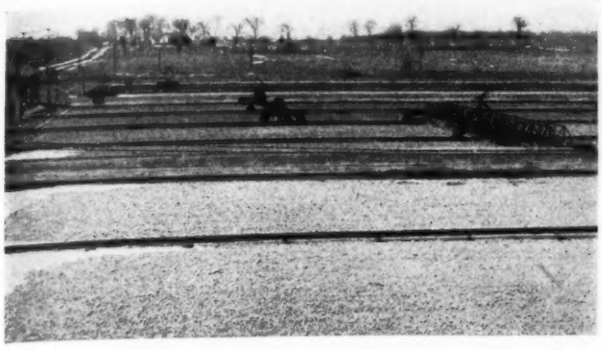
*Twin Dosing Tank and Sprinkling Filters, Bennett Street Sewage Plant, Springfield, Mo. (Dorr Clarifiers and Separate Digestion.)*

*One of Springfield's Sewage Treatment Plants. Imhoff Tank with Sprinkling Filters Beyond. Filter Equipped with Traveling Distributors.*

Our laboratory has also been used to determine experimentally the effect of chemicals in the treatment process In short, our laboratory is the guiding hand that directs our operation activities and at the same time is the yardstick which measures the results of our efforts.

## Controlling Odors of First Importance

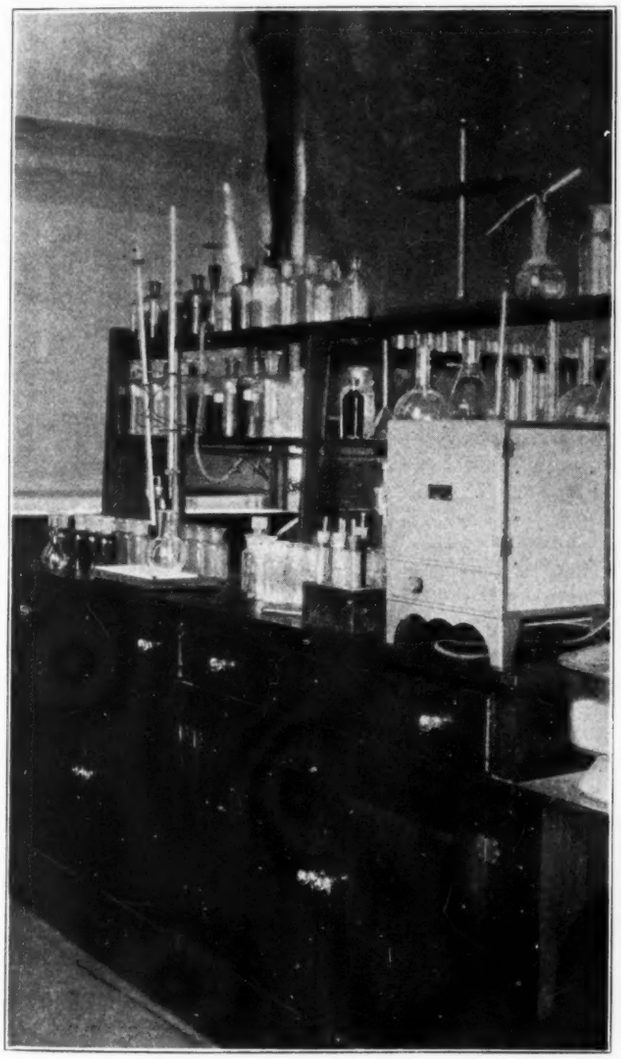
Increasing demands for odorless plant operation during the last five years have made it necessary to control odors as much as possible. At the Imhoff plants, the raw sewage is chlorinated about 1,500 feet above the plants with great effectiveness. At one plant, a chlorine dose of about 50 lbs. per million gallons is used with the result that the nearest resident, whose home is 341 feet from the Imhoff tank, is not bothered with sewage odors. This amount of chlorine eliminates filter flies and converts the sewage odors from the sprinkling filter bed to a clean fresh scent. A much lower dosage, (20 lbs. per m. g.) is sufficient at the other Imhoff plant because traveling distributing troughs, instead of the customary nozzles, feed the sewage to the rock filter bed. This method of distribution avoids spraying the sewage into the air and results in lessening the release of odors thereby. Plans have been made to treat the raw sewage of our separate sludge digestion plant, the largest plant in the state, with chlorine next



*Rectangular Sprinkling Filters Equipped with Electrically-Driven Traveling Distributors, Springfield, Mo. Filters Are 50x200 ft. in Area. Distributors Travel Length of Bed in 4 Minutes. Note Trolleys and Overhead Wire.*

year, and at that time Springfield's problems of sewage odor will be practically solved.

In the operation of Imhoff tanks, we have found squeegeeing or scraping the inclined walls very helpful in maintaining clean flow thru chambers. This prevention of accumulations on the walls aids materially the operation of this unit of the tank. Our antiquated tanks have walls with a slope of 1:1 instead of the greater inclination now in practice. Deposits build up rapidly and interfere with the settling action if they are not removed.



*Sewage Laboratory, Springfield, Mo.*

The great value of a little landscaping was demonstrated this year at our small Imhoff plant. Common flower beds were planted generously about the grounds and were placed so as to hide the units as much as possible. The cost of the planting was negligible compared to the benefits. This beautification, along with deodorization by chlorination, made the plant grounds a most attractive and pleasant place as opposed to the barren appearance that formerly existed. From the seeds developed on this plot, we shall be able to beautify more at the other plants without cost next year.

## Importance of Records

In addition to the chemical and biochemical observations on the receiving streams, we have available, thru the generous cooperation of the United States Geological Survey, discharge measurements of Wilson Creek, which receives the greater amount of Springfield's sewage effluent. The records cover a period of nearly a year and a half now. They have been very valuable in giving the existing dilution available, and in this way give the degree of purification required to prevent pollution of the stream. When the opportunity arises to make some permanent improvements, such records, together with the plant flow, will be indispensable to an intelligent design of these structures.

At Springfield, sewage plant operation requires constant attention. Daily observations, both in the field and in the laboratory, are necessary to keep the plants operating effectively and to prepare for the future demands that are sure to be made on the works. We hope to be able to pass a sewer bond issue in the near future. The construction made possible by this bond issue will bring Springfield's sewage plants up-to-date, and would be a great step toward its goal of complete sewage treatment.

*Acknowledgment:* A paper presented before the Missouri Water and Sewerage Conference held at Jefferson City, Mo.

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## Improved Indicator for Alkalinity (a Correction)

In our July issue on page 236 there appears a formula for an improved indicator for alkalinity or acidity titration which we credited to Aug. G. Nolte as being the originator. We understand now that Mr. A. V. Graf, Chief Chemical Engineer, Department of Water Supply, St. Louis, Mo., was its real originator —having developed it in the St. Louis laboratory several years ago when Mr. Nolte was in charge. We are advised that the formula is a modification of one developed in the Eastman Kodak Company laboratories at Rochester, N. Y., and the Xylene Cyanole can be purchased from this firm to make a solution containing 1.5 gms. Methyl Orange and 0.35 gm. of Cyanole in 1 liter of water. Use one drop to a 100 milliliter sample.

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## Major Philip B. Fleming Assumes P.W.A. Duties of Col. Waite

Major Philip B. Fleming has been appointed Deputy Administrator of the P.W.A., to fill the vacancy created by the resignation of Col. H. M. Waite. Major Fleming, who has been Executive Officer of the P.W.A. and Col. Waite's principal assistant for the past year, was previously Chief of the Finance Division (Office of the Chief of Engineers) and also a member of the War Department's Board on Contracts and Adjustments.

# FIRE PROTECTION CHARGES FOR MUNICIPALLY OWNED WATER WORKS

By CHARLES H. CAPEN, JR.

*Consulting Engineer, West Orange, N. J.*

*The Author*

ADEQUATE fire protection involves a number of different and, frequently, too distinctly separated types of services. The most important of these are water supply and fire departments. It would be unwise and impracticable to say that one of these is more important than the other. The old saying that "a chain is no stronger than its weakest link," applies with singular significance in this case. Fire departments have, by common practice, been financed out of municipal budgets, whereas, water supplies are in a large measure, if not wholly, self-sustaining. This discussion is limited to water supplies with particular reference to the cost of supplying water for fire protection service.

## Growth of Water Supplies

When community water systems first came into vogue in the United States in the latter part of the eighteenth century, the principal purpose of the systems was to deliver a supply of potable water for domestic purposes. The value of the supply for commercial and fire protection purposes was only incidental. Later these two factors assumed a continually increasing importance. It may be easily visualized that under such conditions the public at large has not realized that such a transition has taken place. Furthermore, it has not been appreciated that municipal water departments have had to gradually assume the burden of providing fire protection under increasingly more stringent requirements, and without receiving adequately, if any, compensation therefor.

By far the greatest progress in the improvement and expansion of water supply systems, insofar as fire protection is concerned, has taken place during the twentieth century and more particularly since adoption, by the National Board of Fire Underwriters on December 14, 1916, of a "Standard Schedule for Grading Cities and Towns of the United States with Reference to Their Fire Defenses and Physical Conditions." Though the latter schedule did not determine rates, it did provide a standard method for rating fire protection service, which might form a reasonable basis for insurance rate revision and standardization by the insurance companies, and thus, indirectly, it had a very important influence in improving the standard of fire protection service rendered by the water works and the fire departments of the country.

The National Board does not attempt to force water works men to meet stipulated demands but, with a wide experience gained from all sections of the country, that Board has been enabled to recommend certain minimum requirements before insurance rates can be lowered. Naturally the water works men try to meet or exceed these requirements in order to obtain as low rates as practicable. In most municipally owned water departments the cost of any such improvements are paid for out of normal revenue and no separate charge is made to the municipality for the service rendered. On the other hand, private water companies, which at one time were somewhat loath to make improvements for such purposes, have in recent years been won over to even more complete coöperation with the National Board requirements than have the municipal departments. This is largely due to the fact that Utility Commissions of the various states have permitted the companies to make a direct charge for the cost of such service.

Water consumption in the United States now averages about 100 gallons per capita while that in European countries is 50 gallons per capita or less. Fire losses in the United States are from four to ten times as great as in Europe. It is therefore apparent that our profligate use of water is greatly exceeded by our extreme carelessness. All of this places a much greater burden on water supply and fire fighting facilities in this country than anywhere else in the world. Someone has to pay for this service and the purpose of the following paragraphs is to point out how much this service generally costs and how these costs should be met.

## The "Inch-Foot" Charge

Well ordered regulation of private utilities, with a certain amount of jurisdiction over municipal utilities, has existed in New Jersey for over twenty years. In fact, it may be said that what appears to be the most equitable method of charging for that portion of water supply costs which are directly attributable to fire protection service is a production of New Jersey regulatory authorities. This is the so-called "inch-foot" charge. While the principles involved were set forth as early as 1910 and 1911, apparently the first actual application of the method was made by the Board of Public Utility Commissioners of New Jersey in 1917. The case involved was that of the Hackensack Water Company which had applied for an increase in rates.

The "inch-foot" charge is derived somewhat as follows: For any given main in the distribution system the cost of laying a main of sufficient size to supply the ordinary domestic and industrial water consumption needs is determined. Thereafter, deducting this figure from the higher cost of the dual purpose main gives the cost chargeable to fire protection service. The sum of the annual charges (including a fair return) on all such fire protection costs, represents the annual revenue that should be obtained. Since fire hydrants require a certain maintenance charge, a fixed sum (generally $10.00 per annum for each hydrant) is deducted from the annual revenue so computed. By dividing the net

income required by the total "inch-feet"* of mains, there is obtained a unit price per annum for each "inch-foot."

It is customary to compute the inch-foot charge for the entire area served by any one water works system and the annual charges are allocated to each territory or municipality in direct proportion to the inch-feet of mains and the number of hydrants in such territory. Therefore, when extensions are made to distribution systems, there starts immediately an annual revenue from that extension. The revenue is based on the same inch-foot charge as that computed for the original system, plus a $10.00 annual service charge on each hydrant thereon. This arrangement has the distinct advantage of giving those responsible for laying the main, the knowledge that a definite fixed return that may be expected on the investment.

Those portions of transmission mains which are provided for fire flows over and above normal water consumption requirements, are included in the derivation in the inch-foot charge. The portion of costs chargeable to fire protection for such structures as impounding reservoirs, pumps and distributing reservoirs, must be determined for each separate case and no empirical method can be set up for its determination. In some states as much as 20 to 50 per cent of the cost of such structures has been charged to fire protection but this condition does not obtain in New Jersey where the tendency has been to make a nominal charge but to lean toward a lower limit rather than charge all that the traffic will bear. Where more than one community is served from the same source, costs for transmission mains and other structures not a part of the distribution system, are usually apportioned on the basis of the population served.

It has been stated elsewhere[1] that the "cost of the portion of the water works involved in fire protection service in this country generally constitutes from 60 to 80 per cent of the entire cost of the physical property in the case of communities having less than 10,000 population; 30 to 40 per cent in communities of about 50,000 population; 20 to 30 per cent in communities of about 100,000 population; and 10 to 20 per cent in the case of our large cities." Presumably in arriving at the above figures considerable weight has been given to the practice in the state of Wisconsin. It is reported that the method used is to compute the entire cost of two separate systems, one that would be adequate for fire protection purposes only and one that would be sufficient for normal water requirements other than for fire protection. The ratio of the former to the sum of the two would represent the proportion of the total actual cost chargeable to fire protection.

In determining the revenue to be derived for fire protection, however, the capital costs are only one factor. The annual return to be realized bears a far different ratio to the total return than do the respective costs. The main reason for this is explained by the fact that the distribution pipes, once laid, require a relatively small operating cost, the principal charges being those for debt service and, sometimes, obsolescence. Thus it has been stated that "the cost of fire protection service in percentage of gross annual revenue has generally been found to be between 25 and 35 per cent; the higher percentages obtaining in the smaller water-works, the lower in the larger."

[1]*Water Works Practice*—Manual of A. W. W. A.—1925.

*An 8-inch diameter main, 1,000 feet long, would represent 8,000 inch-feet and the sum of all such figures gives the total inch-feet in the system.

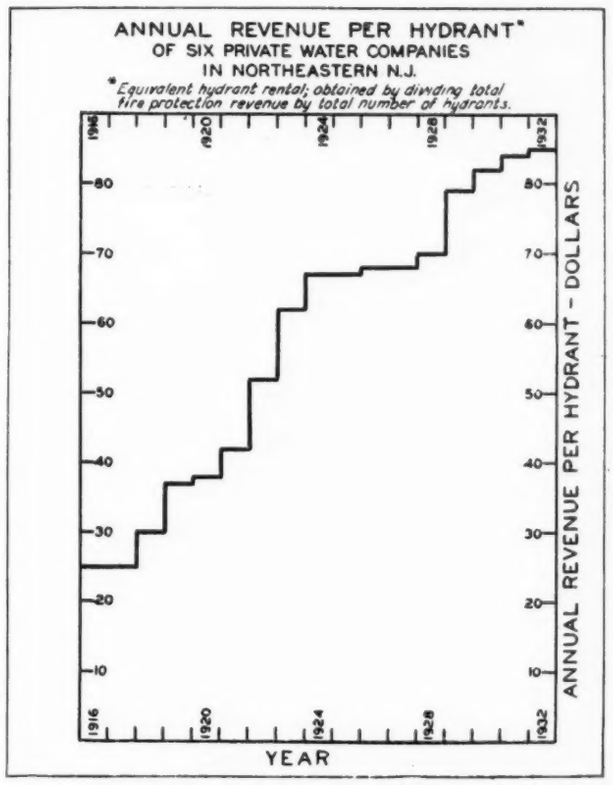



*Chart Showing Annual Revenue Per Hydrant of Six Water Companies*

## Practical Applications

An analysis of revenues received for this purpose by the six largest private water companies in northeastern New Jersey (supplying nearly 50 per cent of all the water used in that district) shows that fire protection revenue increased from a weighted average of 6 per cent of gross annual revenue in 1916 to 13 per cent in 1930. While this increase has been a more or less gradual one, it must be noted that the upturn in the ratio occurred in 1917 when the inch-foot charge was first used.

Comparison of inch-foot charges in various localities is difficult because of the variables involved. It has, therefore, become somewhat customary when comparing the fire protection charge in one municipality with that in another, to divide the total fire service revenue by the number of fire hydrants, thereby obtaining a theoretical figure (termed "equivalent hydrant rental") which serves to show comparative costs. Figure 1 shows the equivalent hydrant rental for a period of years for the territory served by the six New Jersey companies previously referred to. This charge was $25.00 per hydrant in 1916 before the inch-foot charge was inaugurated. In 1924 it was $67.00 and in 1930 it was $82.00 per hydrant. The change was rapid during the years 1917 to 1924 when all of the companies were instituting rate cases for the purpose of obtaining revenue on the inch-foot basis. Since 1924 the increase has been gradual and the percentage change has been much less.

In northeastern New Jersey there are more than one hundred municipalities paying for fire protection service on the inch-foot basis. Most of this group are supplied by private water companies. In 1932 the weighted average (equivalent) hydrant rental charged these municipalities was $85.00 per annum. The minimum was $25.00 and the maximum $122.00 per hydrant.

Various other methods may be used to show the comparative cost of this type of service, and the attached

table (Table 1) reveals a comparison of such charges in New Jersey with those elsewhere.

TABLE 1.—FIRE PROTECTION REVENUE OF SIX LARGEST WATER COMPANIES IN NORTH-EASTERN NEW JERSEY COMPARED WITH AVERAGE FOR UNITED STATES AND WISCONSIN
(All figures are weighted averages)

| | Six New Jersey Companies | | | | United States | Wisconsin |
|---|---|---|---|---|---|---|
| | 1916 | 1923 | 1930 | 1932** | 1923 | 1923 |
| a. Per cent of gross annual revenue.. | 6 | 10 | 13 | 16 | 15 | 30 |
| b. Cents per capita | 35 | 77 | 113 | 112 | 74 | 100 |
| c. Cost per hydrant (dollars) ..... | 25 | 62 | 82 | 85 | 46 | 42 |
| d. cost per mile of pipe (dollars). | 157* | 408* | 565* | 550* | 360 | 329 |
| e. Cents per inch-foot ..... | Not used at this time | 0.80 | 0.98 | 1.00 | 0.98 | 2.25 |

**Largest company taken over by municipalities and therefore omitted in 1932.

*For distribution mains only. Figures for U. S. and Wisconsin may include transmission mains.

The picture insofar as municipal water departments is concerned is far different and, to a large extent, dismal. Very few states exercise the complete jurisdiction over municipal supplies that is done in connection with private utilities. Wisconsin, in its regulation of municipally operated utilities, is outstanding in this respect. In New Jersey the municipalities are required to make complete reports but the Board of Public Utility Commissioners has no power to fix rates. Many municipally owned water departments that are now suffering deficits would be materially aided by a fixed fire protection charge of adequate proportions. It should be noted that the fire protection revenue received by private companies has increased during the depression. This has come about as the result of application of inch-foot charges to necessary extensions, and increases permitted by the Utility Commission on account of increased taxes on water company properties. This means that a substantial portion of the revenue remains uniform in proportion to the capital investment, regardless of economic or industrial conditions.

## Specific Example

For the purpose of demonstrating the effect that the addition of fire protection revenue would have in a particular instance, a municipality which will be called "Aton" has been chosen, largely because in the late twenties it constructed a number of large mains for adequate fire protection service. With the arrival of the depression immediately thereafter, the city of Aton has suffered considerably from inadequate revenue. The supply works are of a type that involve a minimum of construction charges that might be charged to fire protection service, thereby reducing to a minimum the error that is introduced by considering only the distribution system and fire hydrants.

Table 2 shows the revenue that might be obtained by Aton by application of the various methods of charging for fire protection service. It is of interest to note that the average of all methods ($41,000) is in exact agreement with the average of the five separate methods applied to Aton on the basis of the 1932 revenue of the five private water companies in New Jersey. With the possible exception of some of the Wisconsin figures, all of these methods give results that are admittedly low.

It must be remembered that there has been a marked increase in New Jersey between 1923 and 1932 in the ratio that the fire protection revenue bears to the total revenue. This probably does not hold true in the case of Wisconsin but does hold true of the average for the United States. In considering the figures in Table 2, therefore, less weight should be given to the revenue computed in the column based on the 1923 average for the United States even though, in the data presented, equal weight has been given to all figures.

In the case of private companies in New Jersey, the revenues received are probably close to the upper limit that the traffic will bear but are still somewhat below the actual cost of the service rendered. The averages obtained in Table 2 are well below the *value* of the service rendered although few public officials would have the courage to attempt to impose a charge for such service on a value basis.

It has been estimated that for average cities the annual cost of the portion of water works built for fire protection purposes was $1.00 per capita on a pre-war basis and $2.00 on a basis of 1925 costs. Assuming that the present dollar has returned in value to a point midway between the two, the present value of the service would be $1.50 per capita and the expected revenue for Aton would be considerably higher than any of the averages shown in Table 2. The writer believes that a revenue between $40,000 and $70,000 per annum (probably $50,000) would be equitable. This represents the sum that should be placed in the municipal budget of Aton and turned over to the water department in return for service rendered. A steady income of this nature would help the water department to meet its heavy debt service on a large distribution system and would greatly reduce the deficits that have occurred in the past.

Carrying this still further, the same revenue ($1.50 per capita) if applied to all of the northeastern section of New Jersey would represent an income of nearly $4,500,000 per year in this territory. Since the income from charges of this nature at present (mostly from private water companies) is about $1,500,000, the net increase in such income would be $3,000,000—*a sum more than double the deficits of all the water supplies in this territory in* 1932. The immediate adoption of this type of charge by all municipal water departments would cancel most existing deficits and produce profits.

Many arguments may be made against the institution of such charges by municipal water departments but the fact remains that many lessons in good financing can be learned from the private water companies and this is certainly an outstanding one. The present day hue and cry for a "pay-as-you-go" plan for municipalities is an excellent one. A start may be made with the water department, giving it adequate compensation for service rendered and permitting a great deal of much needed extension and re-inforcing of distribution systems. Such a procedure would result in improved facilities and service, reduced insurance rates and would provide a large amount of local employment yielding permanent benefits.

TABLE 2.—POSSIBLE FIRE PROTECTION REVENUE FOR "ATON," NEW JERSEY, ON BASIS OF VARIOUS METHODS OF CHARGING

| | On basis of 1932 revenue of 5 large N. J. Companies | On basis of 1923 average for U. S. | On basis of 1923 average in Wisconsin | Average of three methods |
|---|---|---|---|---|
| a. Per cent of gross annual revenue.. | $49,000.00 | $45,000.00 | $90,000.00 | $61,000.00 |
| b. Cents per capita. | 50,000.00 | 33,000.00 | 45,000.00 | 43,000.00 |
| c. Cost per hydrant (dollars) ..... | 42,000.00 | 23,000.00 | 21,000.00 | 29,000.00 |
| d. Cost per mile of pipe (dollars).. | 28,000.00 | 19,000.00 | 17,000.00 | 21,000.00 |
| e. Cents per inch-foot* ..... | 37,000.00 | 36,000.00 | 77,000.00 | 50,000.00 |
| Average ..... | 41,000.00 | 31,000.00 | 50,000.00 | 41,000.00 |

*A charge of $10 per annum has been added for each hydrant.

# THE TREND OF MODERN TASTE AND ODOR CONTROL*

By F. E. STUART, Research Engineer
*Industrial Chemical Sales Co., New York City.*

*F. E. Stuart*

TASTES and odors continue to be subjects of widespread interest. Whenever a water supply develops an off taste or peculiar odor, immediate steps should be taken to improve the palatability of the water. Water works men concede this to be a sense of duty to the consumer and likewise of unquestionable value in keeping public relations in accord.

With the methods of control now at hand there is little excuse for tolerating tastes and odors whereas in the years just past many cities were known to have a characteristic taste or odor in the tap water which was accepted in lieu of something superior.

The steps of most importance in eliminating these characteristic tastes are: a—Prechlorination; b—Ammonia Chlorine treatment; c—Powdered Activated Carbon treatment.

With the increasing use of prechlorination there is less loading of filters and a lifting of the responsibility placed on final chlorination. This means that chlorine residuals can be maintained in the post treatment with greater degrees of accuracy. Prechlorination therefore not only gives double assurance in sterilization control but it renders more certain the elimination of a major taste problem, that of producing a safe water for distribution with low chlorine residuals.

Soon after the advent of continuous prechlorination came the introduction of ammonia used in combination with chlorine. This treatment soon proved beneficial in preventing byproduct tastes, eliminating chlorinous tastes produced by the necessary high dosages of chlorine in the post treatment. It constituted a decided step in taste and odor control.

Investigators began to study the sterilization efficiencies of chloramines. Some claimed a "lag" in sterilization, while others claimed that no "lag" resulted. Other arguments regarding the importance of high and low pH values and temperature effects in sterilization were brought up. With the use of prechlorination to satisfy the demand of the water sufficient to produce a safe effluent, ammonia-chlorine treatment can be used with complete safety, resulting in agreement of both groups of investigators.

Some investigators found the application of ammonia-chlorine in the pretreatment to be the most beneficial and this continues as common practice in many plants.

Ammonia-chlorine treatment has proven itself to be an added safeguard for taste and odor control in most every instance. It is primarily a taste and odor prevention process. The process prevents chlorinous tastes from developing when high dosages of chlorine are required or when the demand of the water is variable and accurate chlorine dosages cannot be maintained. Prechlorination and ammonia chlorine caused the public to become sensitive to variations in tastes and odors—that is to say the two methods aided so much in the production of a more palatable water that whenever a taste did get beyond their control, the consuming public noticed. Then followed the modern powdered activated carbon process of taste prevention and removal.

## The Powdered Activated Carbon Process

Since the introduction of Aqua Nuchar (activated carbon) in 1930 considerable plant scale experience has been obtained. Much of this work has been done in Virginia through splendid cooperation by the State Department of Health under the direction of Mr. Richard H. Messer and in cooperation with the cities of Suffolk, Newport News, Norfolk and Richmond.

The early investigators of carbon treatment found that a suspension of carbon applied directly to the filters would improve the palatability of the water in a few hours. The average dosage was 2 ppm, (16 pounds per million gallons) applied as a suspension from a barrel at a strength of 5 pounds carbon to 50 gallons of water. Shorter filter runs resulted in most every instance; however, the removal of the taste producing compounds offset the inconvenience of shorter filter runs.

Later investigators found that Aqua Nuchar could be applied to the mixing chambers at the same dosage (16 pounds per million gallons) by dryfeed machine equipped with water ejector. This method of application had the advantage of removing tastes without shortening filter runs. It was found later, however, that it was advisable to apply carbon directly to the filters to "seed" them with carbon particles before beginning the treatment in the coagulation process.

## Importance of Sludge Stabilization

About this time, an investigator in Florida found that carbon applied in the coagulation process would inhibit bacterial activity in the settled floc. This development is now known as "Stabilization of Sludge" and has become an important factor in securing maximum hygienic cleanliness in a filter plant.

It has been found that carbon will increase the efficiency of the coagulant by keeping the settled impurities in a sweet condition. In many instances carbon particles have aided coagulation, acting as a nuclei for floc formation, possibly acting catalytically as carbon sometimes increased the efficiency of coagulation processes also in turbid waters and in softening plants.

Listed below is an abstract of a recent questionnaire showing points of application of carbon and the percentage of plants in each instance using the method.

(a)—On the filter.....14 per cent
(b)—In settling basin.....19 " "
(c)—During the coagulation process....14 " "
(d)—Direct with the coagulant.....53 " "

This is quoted to show that many plants have found

*Presented before the Virginia Section of the A. W. W. A. at Martinsville, Va., July, 1934.

stabilization of sludge so important a factor that they use a small amount of carbon either separately or mixed with the alum continuously in order to keep the plant in a "sweet" condition.

To show dosages required for this work an abstract from the report of the committee on the Control of Tastes and Odors of the A. W. W. A., 1933 is given below.

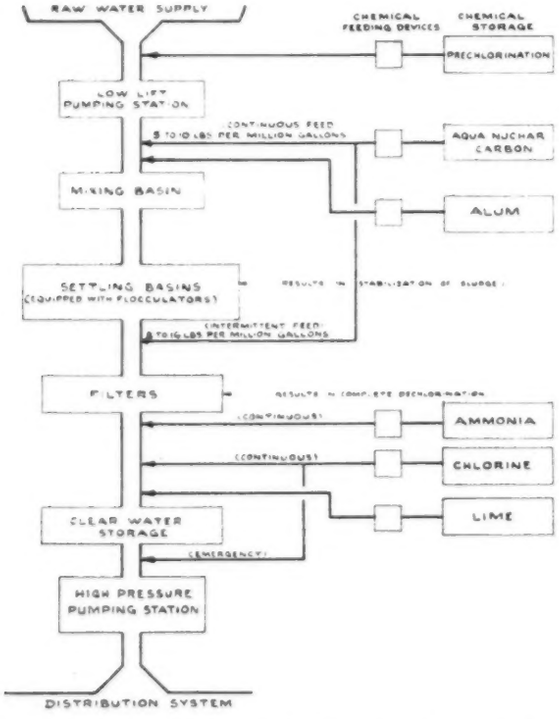
| *Dosages Applied* | *Plants* |
|---|---|
| 1— 5 lbs. per million gallons | 23 per cent |
| 5—10 lbs. per million gallons | 30 " " |
| 11—15 lbs. per million gallons | 16 " " |
| 16—20 lbs. per million gallons | 12 " " |
| 21—30 lbs. per million gallons | 10 " " |
| 30—90 lbs. per million gallons | 6 " " |
| 91—100 lbs. per million gallons | 3 " " |

This shows that in 81 per cent of the plants reporting use between 5 and 20 pounds per million gallons for taste and odor control. It is this factor that makes the routine use of Aqua Nuchar economical.

Where the water supply is obtained from streams carrying heavy industrial trade waste pollution, higher dosages are necessarily required, and should be used to insure complete taste and odor removal.

## The Trend of Modern Taste and Odor Control

The trend of modern taste and odor control involves the use of prechlorination with carbon applied at dosages from 5 to 10 pounds per million in the coagulation process. Complete dechlorination is accomplished by the carbon particles in the floc deposited on the filters. Residuals can be maintained farther thru the basins when carbon is used because gases of decomposition are not present to react with the residual chlorine, and remove it. After filtration, ammonia and chlorine are added in sufficient quantities to meet local conditions. The application of ammonia and chlorine to filtered water conditioned with prechlorination and carbon will in most every instance keep down taste and odor complaints. Whenever the routine treatment of prechlorination and carbon in the coagulation process, with the resulting stabilization of sludge and dechlorination at the filters, allows a taste to develop that the ammonia chlorine process after filtration will not control, the addition of more carbon directly to the filters will in most every instance remove the taste. The average dosage of carbon, applied directly to the filters (see attached flow sheet) is 2 parts per million—16 pounds to a million gals.




*Flow Diagram for Chroline Carbon and Ammonia-Chlorine Treatment.*

## Activated Carbon in Wash Water Holds Promise

The most recent development in taste and odor control originated in Norfolk, Virginia, where R. W. Fitzgerald is cooperating with the writer on the application of carbon particles to wash water. The dosage at this time is at the rate of 4 pounds per million gallons applied to the filter when washing. The results will at a later date be published by R. W. Fizgerald.

A duplicate experiement is under way at the Easton, Pa., plant of the Lehigh Water Company under the direction of R. W. Haywood. This method of taste control looks promising as filters are running longer and apparently removing more taste producing organisms.

## Summary

Summarizing: the trend of modern taste and odor control is the heavy application of chlorine in the pretreatment; the addition of 5-10 pounds per million gallons of Aqua Nuchar to the mixing chamber which gives improved coagulation, stabilization of sludge and subsequent dechlorination: the addition of ammonia and chlorine after filtration in sufficient quantities to meet local conditions. When tastes develop that the ammonia-chlorine process after filtration will not control, additional Aqua Nuchar is applied as a suspension directly to the filter influent at an average dosage of 2ppm, (16 pounds per million gallons).

The addition of carbon particles to wash water to "sweeten" the filters and increase their efficiency is giving promise of becoming a worth-while procedure.

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## A. W. W. A. Demands Safe Water in Hotels

In view of the serious amebic dysentery epidemic created by sewage entering the water systems in two prominent Chicago hotels, resulting in almost 1,000 known cases and more than 50 deaths, the American Water Works Association adopted a resolution at its 1934 Annual Convention, to the following effect:

That: the hotel in which an A. W. W. A. convention is to be held shall be required to submit a certified plan of its water supply and drainage piping systems, together with a certificate from its State Department of Health, to the effect that no dangerous or unsanitary conditions exist on its premises.

The American Society of Civil Engineers has adopted a resolution of similar import. Thereby, these two associations are not alone insuring a protection to its members but are establishing a precedent which directs greater attention to all cross connection hazards. Why stop at hotels? Is it not proper that the A. W. W. A. demand that the entire city system be cleared of cross connections of a hazardous character, or else lose the patronage of the Association.

# EDITORIALS

## The Value of Licensing Operators

IN the water-works and sewerage fields interest in Operator Licensing Laws is widespread. The subject has become a live topic for discussion at the meetings of practically every water-works and sewerage association or conference in America—and justifiably so. In fact, many such organizations have active committees studying the three existing Operator Licensing Acts—those of New Jersey, Michigan and West Virginia—for the purpose of evaluating them; and, with the intent of drafting an act which will embody the best features of each of the three acts, which may prove adaptable under conditions existing in that particular state.

In each of the states which have already put into effect Operator Licensing Laws the workings of the law and its enforcement has been placed in the hands of the State Health Departments as the best equipped agency to handle the matter—and very properly so, because of the close relationship between engineers of these Departments and water-works and sewerage operators. In addition, universities or state colleges have played an important part in making the act successful by offering Operator's Short Courses wherein those seeking their first license or a higher grade of license can receive the tutition necessary to the successful passing of the required examinations.

Since West Virginia has been the most recent of the states to place in operation an Operator's Licensing Act, it was interesting to hear first hand opinions and discussion of its merits by operators and water works managers at the recent meeting of the West Virginia Water Purification Conference, which is reported elsewhere in this issue.

Operators told of the fears initially felt by them when informed that they would be required to become licensed by standing an examination; but, that with the aid of the pre-examination courses offered by the University of West Virginia in co-operation with the State Department of Health, they had been able to successfully pass the examination—what is more, had learned a lot about plant control and operation. Considered first as a bugaboo, they now appreciated the value of the new law—not alone in raising the quality of operation, but in assuring the license greater security of position in periods of political upheavals.

From managers of water companies and superintendents of water departments came praise of the good which had come as the result of the operation of the new law in Michigan and West Virginia. It was also clear that private water companies had found that the act had worked no undue hardship on them and had been well received as a meritorious development for the good of all concerned.

It was also revealed that patterned on the courses of pre-examination instruction, given by Professor Carpenter at the University of West Virginia, weekly classes of shift operators had been held at one or more filtration plants in the state—notably at Clarksburg—with gratifying results, as evidenced by the increased interest shown by these men in their work. So, the courses given by the university were seed on fertile soil. The "extension course" being offered "at home" by superintendents of filtration is a worth-while by-product of the West Virginia Licensing Act.

From the State Health Department representatives it was learned that the better qualifications of operators, incident upon the licensing act, had been evidenced by the reduced number of calls upon the Department by operators seeking help and assistance on minor problems. Further, that municipalities being prevented from putting green local men in charge of plants—heretofore requiring the State's time and expense of training them—now realized that in making a change it would be necessary to go elsewhere to secure a qualified (licensed) man. Thereby, the law proves very discouraging to the replacement of operators without cause more justifiable than their religious, fraternal or political affiliations.

The unfolded soundness and merit of Operator's Licensing Acts should insure their rapid spread to practically every State in the Union—especially now that operators themselves have come to realize the value that such acts have in respect to their own well-being in addition to the general safeguards which they offer against faulty operation and hazard to the health of a community. Municipal officials, who are honest at heart, will realize the economic benefits which the law effects in making it impossible for less considerate officials to man a plant with the most expensive type of operator—the green man—whose irresponsibility or ignorance may well result in costly damage to machinery or waste through less efficient maintenance and operation. Money can be easily wasted by inexperienced operators in the form of chemicals wasted and wasteful pumping schedules that are not planned for the most economical use of electric current, including its maximum use at off-peak rates. Other forms of damage, due to inexperience, are well known to engineers of the State Health Departments.

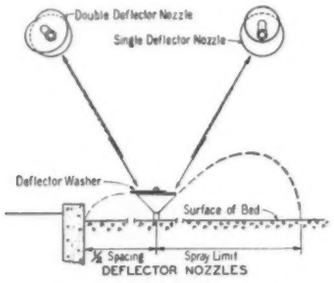
A feature of the West Virginia Act is the requirement that a licensed man be on duty at water purification plants during all shifts. That means each shift operator must have received some one of the three grades of operator's license in order that dependable operation can be expected by the superintendent or chief operator during periods when he is off duty. This seems a sound and commendable feature. Another element of interest is the complexion of the West Virginia Examining Board. Written examinations are numbered to hide the identity of the applicant and the grading is done by a representative of the Department of Health, the head of the Sanitary Engineering Department of the University and by selected plant operators—the three independent gradings being weighted in arriving at the average. The representation of operators is a strengthening feature and has insured this group a participation in the ratings assigned. Naturally the academic training and experience of applicants counts in the final grading but the result of the written examination reveals the degree and interest manifest by the operator in qualifying for a license.

With the several states studying or drafting Operator's Licensing Acts one may expect a general raising of the quality of plant operation, greater interest and security of operators, higher quality of water and sewage effluents. Furthermore, licensing will without doubt result in procuring a general higher plane for operators and enhanced respect of municipal officials for water works men, the lack of which was so expressively lamented by H. E. Jordan, President of the American Water Works Association, in an address before the Central States Section and the West Virginia Conference, reported on another page of this issue.

# NEW EQUIPMENT AND LITERATURE

## P. F. T. Deflector Nozzles

To avoid wasted or ineffective areas around the edges of sprinkling sewage filters and at the same time to prevent splashing (by fixed spray nozzles) over the side walls, Pacific Flush Tank Company have developed three improved types of deflecting nozzles—one being illustrated above. Equipping filters with such nozzles, at distributing lateral ends, makes the filtering area more nearly 100 per cent available than has been before attained. These nozzles are available in single, double or




*P. F. T. Deflector Nozzle*

half spray design and the adjustable feature of the deflector makes for added flexibility and more perfect coverage of the stone area.

Pacific Flush Tank Company advocate the fixed spray type of sewage distribution as the most dependable and least expensive to maintain because of ruggedness of construction, absence of moving parts, freedom from corrosion troubles. The deflector nozzles have been developed to further improve the system of fixed spray distribution.

Bulletin 112 describes and illustrates applications of deflector nozzles. A copy of it and catalog 30—describing P. F. T. syphons and dosing tanks—will be sent upon request to Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

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## Kreolite: A New Metal Preserver

Kreolite metal preserver, a product recently perfected by the Jennison-Wright Co. of Toledo, O., for many years producers of efficient wood preserving compounds, has been shown to possess exceptional merit as a protector of metal surfaces against ordinary rusting and corrosive attack by acids, alkalis and sulphur fumes. It also serves as a waterproofing material on wood, stone and concrete.

Tests and demonstrations conducted over periods of several months at sewage treatment works have proved Kreolite to be especially adaptable and an effective protective coating for sludge pumps, metallic mechanisms (exposed or submerged) and concrete subjected to the corrosive action of sewage, industrial wastes, chlorine and sewer or sludge gases.

For water tanks and exposed surfaces where a bright finish is desired Kreolite Karbolumino, a modification of the metal preserve, is being offered. Both products are quick drying and produce an elastic, glossy surface.

For liberal samples, to use in a test of durability, and for additional information, address Jennison-Wright Company, Chemical Department, Kreolite Building, Toledo, Ohio.

▼

## Economy Non-Clogging Pumps

A new bulletin of 8 pages illustrating and setting forth distinctive features of Economy non-clogging pumps has recently been issued by Economy Pumping Machinery Company of Chicago. With waterways sufficiently large to pass any solid object which will enter the suction pipe, these pumps are produced with capacities from 50 to 10,000 g.p.m. against heads up to 120 ft. The bulletin contains capacity and dimension tables and descriptive details pertaining to pump design and materials of construction.

Ask for Bulletins F. 434 (Horizontal) and F. 534 (Vertical). Address Economy Pumping Machinery Company, 3431 W. 48th Place, Chicago, Ill.

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## Foxboro Rotax Controller

The Foxboro Company, for years manufacturers of precision indicating and recording instruments, have just announced the development of Rotax controllers, designed to serve as altitude gages and as controllers of liquid levels, flows, pressures and temperatures.

The use of electrical transmission in operating Rotax controllers makes for flexibility and greatly widens the field of their application. The whole assembly of the instrument is built around their Fox-

*Foxboro Rotax Controller*

boro patented pivoted pen arm movement which makes for use of manipulation and simplicity of construction. Silver and platinum are the metals used in all surfaces and segments making contacts to close electrical circuits, start or stop pumps, open or close valves, etc.

It is becoming increasingly important (often more economical) to attain flexibility in pressures during various periods of the 24-hour day, or at various points on the systems; to secure more adequate and dependable control of water levels in tanks or reservoirs; variable rates of pumping and frequency of operation of booster pumps. These phases of water works operation are receiving more attention than ever in the past. The same applies in sewerage system and treatment plant operation also, but to a lesser degree. It is for these reasons that automatic controlling mechanisms, such as the Rotax, are becoming more widely employed.

The Foxboro Company has for distribution an educational bulletin, picturizing graphically 8 typical applications of such controllers, citing specific performance records of Rotax controllers in actual service and describing the instruments.

Request Bulletin D. M. F. 646—Rotax Control. Address The Foxboro Co., Foxboro, Mass.

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## *Better pH Control*

Under the title "Better pH Control," Hellige, Inc., of New York City have recently issued a new and interesting bulletin. It pictures and describes the variety of handy equipment supplied by this firm for laboratory, factory and field use in making pH determinations—easily; quickly; accurately. Hellige pioneered in glass color disc standards and now after several years of experience are able to guarantee their color discs against fading for an indefinite period of time. The new bulletin stresses the simplicity and compactness of Hellige equipment, made possible by the use of glass disc standards.

The Hellige Simplex Tester is relatively new, is compact and moderately priced and can be used for many colorimetric determinations other than that of pH value. The Standard Slides (not discs in this instance) are interchangeable. The Hellige Titration Comparators and Wedge Type Colorimeter are illustrated and described as are the better known Standard and Pocket Model Comparators, employing glass disc standards. The "A. N. A." Testkit, with wide range indicator, for quick approximate determinations of pH values 3 to 11 (in steps of 0.5 pH) is compact, unique and very inexpensive.

Ask for Bulletin 600—"Better pH Control." Address Hellige, Inc., 177 E. 87th St., New York City, or this magazine.

▼

## *New Brown Resistance Thermometer Catalog*

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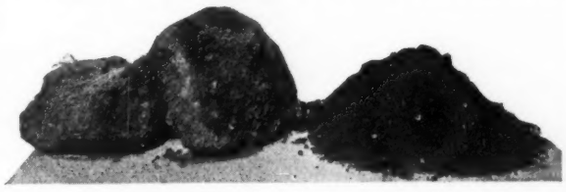

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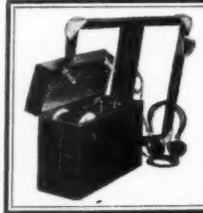

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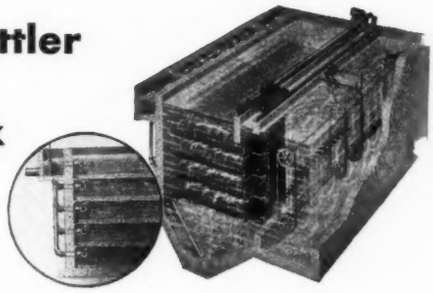

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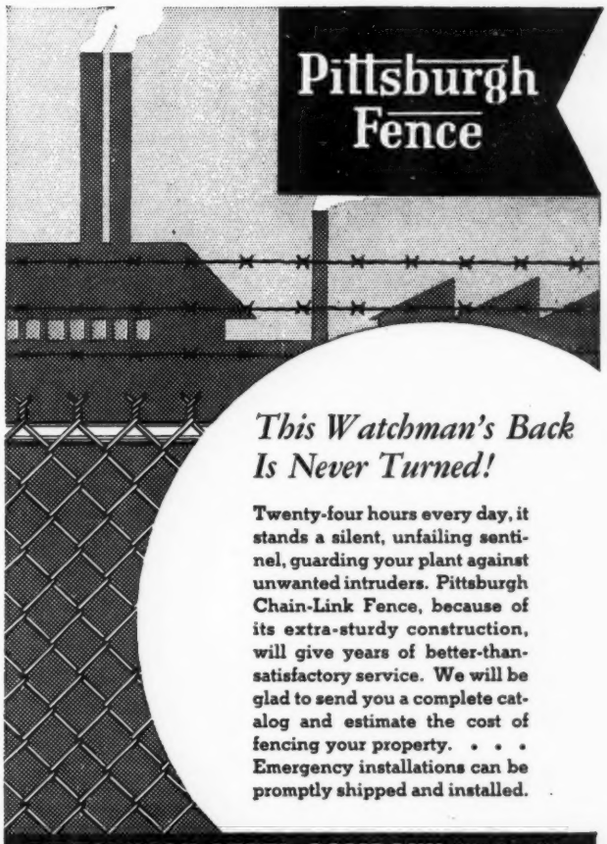


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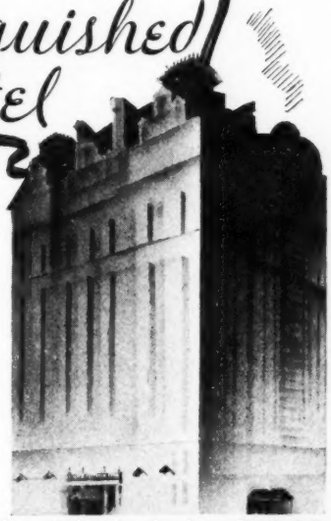

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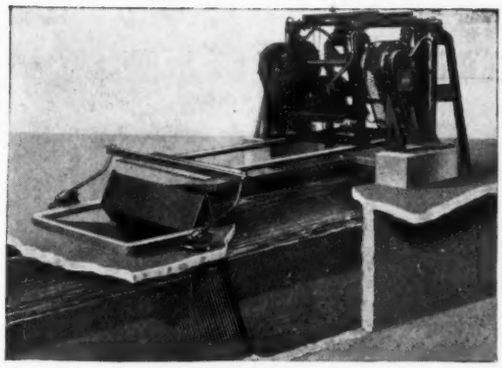

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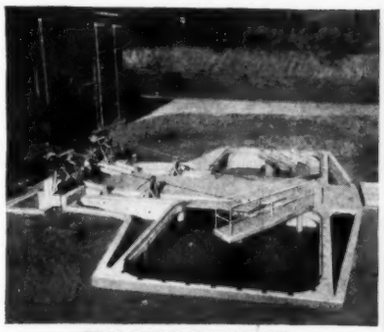

TWO DORR DETRITORS

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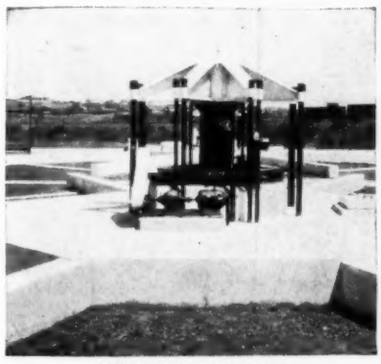
It is more than just a coincidence, that a skilled engineering staff, built up and trained to service each machine from start to finish, averages ten years in our employ.



THE DORR DIGESTER

THE DORRCO DISTRIBUTOR

More than a coincidence, too, that the lowest cost activated sludge plant and the lowest cost separate digestion plant in the United States are both completely Dorr equipped.

And it could hardly have been a mere coincidence that Dorr machines and methods are daily entrusted with the treatment of several billion gallons of sewage, water and trade wastes in hundreds of plants in 14 nations of the world.

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DORRCO

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FRANCE: Soc. Dorr-Oliver, Paris
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# • FAMOUS VICTIMS OF WATER-BORNE DISEASES*

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